

**TECHNICAL MEMORANDUM**

10 January 2020  
File No. 129687-012

**TO:** Florence Copper Inc.  
Richard Tremblay, Vice President Operations

**FROM:** Haley & Aldrich, Inc.  
Mark Nicholls, R.G.

**SUBJECT:** Summary of the Cause for Exceedance of the Bulk Electrical Conductivity Alert Level at the PTF Wellfield

**Introduction**

Florence Copper Inc. (Florence Copper) operates the Production Test Facility (PTF) wellfield for the purpose of demonstrating the feasibility of In-Situ Copper Recovery (ISCR) methods to recover copper from the Poston Butte copper deposit in Florence, Arizona. The PTF is authorized by Temporary Aquifer Protection Permit (APP) No. P-106360 and Underground Injection Control (UIC) Permit No. R9UIC-AZ3-FY11-1. Section 2.2.4 of the APP requires that Florence Copper measure bulk electrical conductivity (bulk EC) to confirm hydraulic control. Section 2.5.9 of the APP sets forth the requirements for establishing ambient bulk EC values, and for calculating an appropriate bulk EC alert level (AL). Section 2.6.2.7 of the APP sets forth requirements associated with a confirmed exceedance of the bulk EC AL.

This Technical Memorandum describes confirmed exceedances of the bulk EC AL on three monitoring horizons at three PTF observation wells beginning on 21 November 2019. In accordance with Section 2.6.2.7(4) of the APP, this Technical Memorandum describes the cause, impact, mitigation of the exceedances, and describes any errors in measurement, data analysis, and statistical evaluation of the bulk EC data.

**Bulk EC Monitoring Description**

In accordance with requirements of the APP, Florence Copper has been collecting bulk EC data weekly, and comparing those data to the ALs established based on ambient bulk EC monitoring conducted prior to the start of PTF operations. The bulk EC compliance monitoring system includes three bulk EC sensors, installed on each of the seven observation wells (identified as O-01 through O-07) at the edge of the PTF wellfield, resulting in a total of 28 sensors. The location of the observation wells relative to the PTF wellfield is shown on Figure 1. The sensors are configured to create four horizontal monitoring

horizons with a vertical separation of 20 feet between each horizon. The monitoring horizons are numbered 1 through 4, with horizon 1 being the highest in elevation and horizon 4 being the lowest. Horizon 4 is located in the middle of the 40-foot thick exclusion zone and is not used for compliance monitoring, but is used for operational monitoring to allow Florence Copper to adjust operations prior to an excursion reaching the compliance bulk EC sensors placed 20 feet above at the contact between bedrock and the lower basin fill unit (LBFU). Bulk EC monitoring horizon 3 is at the bedrock LBFU contact, monitoring horizon 2 is 20 feet above the contact within the LBFU, and monitoring horizon 1 is 40 feet above the contact also within the LBFU.

Monitoring is conducted by serially energizing each of the individual sensors on each monitoring horizon and recording the relative signal at each of the other sensors on that monitoring horizon. The resulting measurement reflects the combined conductivity of all material and fluid between the energized sensor and the receiving sensor. The sending and receiving sensors are referred to as “sensor pairs” throughout the remainder of this document. The value measured between each sensor pair is referred to as “bulk conductivity” because it reflects the combined relative conductivity of the formation material, groundwater, well casings, annular materials, and injected fluid (if present) between the sensors. Bulk EC values are reported in terms of resistivity, which is the inverse of conductivity, and the reporting units are ohm-meters ( $\Omega\cdot m$ ).

The bulk EC AL values are a lower limit, consequently a bulk EC value that declines below the AL is characterized as an exceedance. Because the injected fluid has significantly higher conductivity than native groundwater, a vertical excursion of injected fluid will result in a localized increase in bulk EC detected at multiple sensor pairs. Florence Copper submitted a proposal in August 2018, that included a description of the method for establishing the bulk EC ALs and included discussion of method sensitivity and factors that may affect bulk EC values.

Based on the configuration of the bulk EC monitoring system, a hypothetical vertical excursion of injected fluid would progress upward from a localized detection of decreased resistivity at the lowest monitoring horizons. Because the ISCR fluid is very conductive, an excursion of fluid from the injection zone would abruptly change the measured bulk EC value in a very short time frame, in contrast to the gradual changes that would be expected from environmental changes or sensor drift. The localized occurrences would expand horizontally on the lower horizons as new detections occurred on the upper horizons. A vertical excursion would thus be detected first on monitoring horizon 4, then on monitoring horizons 3, 2, and 1, in that order. A vertical excursion of injected fluid would be accompanied by the following sequential observations:

1. Localized detection of reduced resistivity at a localized area on monitoring horizon 4.
2. Localized detection of reduced resistivity at a localized area on monitoring horizon 3 and expanding localized detection of reduced resistivity on horizon 4.
3. Localized detection of reduced resistivity at a localized area on monitoring horizon 2 and expanding localized detection of reduced resistivity on horizons 3 and 4.
4. Localized detection of reduced resistivity at a localized area on monitoring horizon 1 and expanding localized detection of reduced resistivity on horizons 2, 3, and 4.

Bulk EC monitoring is an effective means to monitor for vertical migration of injected fluid above the exclusion zone but relies on the assumption that migration of injected fluid is the only changing condition within the wellfield, and that all other factors affecting bulk EC remain unchanged during PTF operations. Consequently, changes in other conditions at the PTF wellfield that affect bulk EC have the potential to depress the resistivity values resulting in an apparent bulk EC exceedance.

## Confirmed Bulk EC Exceedance

Bulk EC data collected on 21 November 2019, reflected a downward shift in resistivity values measured between all sensor pairs on all monitoring horizons. The downward shift in resistivity values resulted in exceedance of the AL at five sensor pairs located on three monitoring horizons. The exceedances were first observed in bulk EC data collected on 21 November 2019, which were reported to Florence Copper on 2 December 2019, following completion of statistical analysis of the raw data. The exceedances were confirmed by bulk EC measurements made on 26 November and 3, 4, and 5 December 2019.

Statistical analysis of the bulk electrical conductivity data collected through 5 December were completed on 10 December 2019. Florence Copper was notified that the exceedances were confirmed on 11 December 2019. The observed changes in bulk EC values measured on 21 November reflect a relative change in bulk EC of between 1 and 8 percent relative to previous measurements. The electrode pairs that indicated exceedance of the bulk EC ALs experienced changes of 2 to 3 percent and exhibited the lowest baseline bulk EC values. The observed exceedances and confirmation measurements are summarized in Table 1.

**Table 1. Summary of Observed Bulk EC Exceedances and Confirmation Values**

Horizon and Electrode Pair*	AL ( $\Omega$ -m)	11/21 Results ( $\Omega$ -m)	11/26 Results ( $\Omega$ -m)	12/3 Results ( $\Omega$ -m)	12/4 Results ( $\Omega$ -m)	12/5 Results ( $\Omega$ -m)	12/11 Results ( $\Omega$ -m)
Horizon 1, between wells O-05 and O-06	9.93	9.77	9.77	9.72	9.72	9.71	9.77
Horizon 1, between wells O-06 and O-07	9.93	9.85	9.84	9.82	9.79	9.81	9.85
Horizon 2, between wells O-05 to O-06	10.12	10.00	9.99	9.96	9.94	9.94	9.99
Horizon 3, between wells O-05 to O-06	10.33	10.28	10.28	10.23	10.22	10.21	10.26
Horizon 3, between wells O-05 to O-07	10.33	10.20	10.20	10.13	10.13	10.10	10.18
*Horizon 3 is the deepest compliance monitoring horizon and is located at the bedrock lower basin fill unit contact and is the closest to the injection zone. Horizon 1 is the shallowest monitoring horizon and is furthest from the injection zone.							

Once the potential exceedances were confirmed, Haley & Aldrich, Inc. (Haley & Aldrich) conducted an evaluation of the wellfield conditions, operations, meteorological changes, and other environmental changes to identify the cause of the exceedances in accordance with Section 2.6.2.7 of APP No. P-106360.

## Comparative Bulk EC Values from PTF Operational Monitoring

In addition to the compliance bulk EC monitoring conducted at horizons 1 through 3, Florence Copper is conducting operational bulk EC monitoring at horizon 4 and at greater depth within the injection zone. The operational monitoring provides for comparison of the measured bulk EC values measured for compliance monitoring with values measured in areas where injected solution is known to be in contact with bedrock, and at locations between the injection zone and the compliance monitoring points.

### OPERATIONAL MONITORING AT HORIZON 4

As described above, APP No. P-106360 establishes bulk EC AL values for monitoring horizons 1 through 3. Horizon 4 is located 20 feet below horizon 3 in the middle of the 40-foot thick exclusion zone and does not have an AL. Monitoring horizon 4 is used for operational monitoring to allow Florence Copper to identify changing conditions prior to a potential vertical excursion reaching the LBFU. The monitoring system is configured such that a vertical excursion would have to pass horizon 4 before reaching the other horizons. Consequently, horizon 4 would thus be expected to have a lower resistivity value than that observed on the higher horizons in the event of a vertical excursion.

Bulk EC data collected at monitoring horizon 4, at the time the exceedances were identified and confirmed on horizons 3, 2, and 1, showed higher resistivity values than the overlying horizons and a similar magnitude of change. This fact indicates that there is no notable differential between the changes observed on horizon 4, relative to the changes observed on horizons 3, 2, and 1, and that there is no residual evidence of upward migration of injected fluid. Table 2 lists the bulk EC values measured on horizon 4 at observation wells O-05, O-06, and O-07 during the monitoring events which detected and confirmed the AL exceedances on horizons 1, 2, and 3.

**Table 2. Summary of Observed Bulk EC Values on Horizon 4 During the Period Exceedances Were Observed and Confirmed on Horizons 3, 2, and 1**

Horizon and Electrode Pair*	AL ( $\Omega$ -m)	11/21 Results ( $\Omega$ -m)	11/26 Results ( $\Omega$ -m)	12/3 Results ( $\Omega$ -m)	12/4 Results ( $\Omega$ -m)	12/5 Results ( $\Omega$ -m)	12/11 Results ( $\Omega$ -m)
Horizon 4, between wells O-05 and O-06	N/A	10.62	10.61	10.57	10.56	10.53	10.60
Horizon 4, between wells O-05 and O-07	N/A	10.47	10.47	10.40	10.39	10.38	10.46
*Horizon 3 is the deepest compliance monitoring horizon and is located at the bedrock lower basin fill unit contact. Horizon 4 is located within the exclusion zone, is monitored for operational purposes, and does not have an alert level.							

### OPERATIONAL MONITORING IN THE INJECTION ZONE

In addition to the bulk EC monitoring system constructed for the purpose of compliance and operational monitoring described above, Florence Copper has constructed an additional bulk EC operational monitoring system within the injection zone to facilitate analysis of fluid flow between the injection and



recovery wells. Operational monitoring within the injection zone began prior to the commencement of injection and has continued throughout 2019. This operational monitoring within the injection zone provides an opportunity to compare bulk EC values, where injected solution is known to be in contact with bedrock, to the observed bulk EC values in the overlying monitoring horizons 1 through 4. The uppermost operational bulk EC monitoring within the injection zone is conducted at a depth of 168 feet below monitoring horizon 4.

Operational monitoring within the injection zone yields bulk EC values that are consistently below 3  $\Omega$ -m throughout the injection zone, and are in the range of 2  $\Omega$ -m at a depth of 168 feet below monitoring horizon 4. If a vertical excursion were moving upward from the injection zone through monitoring horizon 4, it is anticipated that bulk EC measurements at horizon 4 would reflect the low bulk EC values observed in the injection zone. However, the bulk EC values measured at horizon 4 remain some of the highest observed in the monitoring network, indicating that a vertical excursion has not occurred.

## **Bulk EC AL Exceedance Cause, Impact, and Mitigation**

### **OBSERVED BULK EC SENSITIVITY TO PRECIPITATION DURING THE AMBIENT MONITORING PERIOD**

Bulk EC monitoring is a highly sensitive method used for detecting changes in the conductivity of the formation materials above the PTF injection zone. As described in the August 2018 AL proposal, this method of monitoring is sensitive to environmental changes in addition to those generated by migration of injected fluid. The AL proposal described potential spatial variability related to lithology, moisture content, fluid temperature, and electrolyte content, and temporal variability related to seasonal changes, meteorological events, and sensor drift.

Baseline bulk EC data was collected at the PTF wellfield between 24 May and 3 August 2018. The baseline bulk EC data showed sensitivity to precipitation events, but relatively low variability (generally less than 1  $\Omega$ -m). The variability of the baseline dataset, sensitivity to environmental changes, and method for calculation of the ALs are described in the August 2018 AL proposal.

Section 4.1.2 of the August 2018 AL proposal describes the effects on the baseline dataset of precipitation events occurring on 16 through 17 June and 29 through 31 July 2018. Both of these events precede notable declines in the bulk EC values compared to values measured before the precipitation events. The 16 through 17 June 2018 precipitation event produced approximately 1 inch of rain and preceded a decline in bulk EC values of up to 0.77  $\Omega$ -m and 5.1 percent compared to pre-event values. The 29 through 31 July 2018 precipitation event produced approximately 0.7 inch of rain and preceded a decline in bulk EC values of up to 1.3  $\Omega$ -m and 4.9 percent compared to pre-event values.

The August 2018 AL proposal noted that rainfall added soil moisture at the surface which would lower temperatures in the surficial infrastructure used to collect the data. Temperature fluctuations change the resistivity of the cables used to transmit the signals to and from the wells from the resistivity instrument as well as the cables at the surface used as reference electrodes. It is also important to note that the ambient bulk EC data were collected over a relatively short period of time in the summer of 2018, and consequently do not fully characterize potential seasonal variability arising from reduced

ambient air temperatures and reduced evaporation of residual soil moisture. These types of seasonal changes have the potential to affect the surficial components of the bulk EC monitoring system, the grounding network, and the reference electrodes used to process the raw bulk EC data. The ambient bulk EC data, observed temporal variability during the ambient monitoring period, and correlation to precipitation events are described in the August 2018 AL proposal.

### **CORRELATION OF OBSERVED CHANGES IN BULK EC AND PRECIPITATION EVENTS**

Comparison of bulk EC data, collected during the operational monitoring period, to precipitation data show correlation between precipitation events and observed declines in bulk EC values. Figures 2 through 8 are time series plots of the average measured bulk EC values at each of the four monitoring horizons at each of the seven observation wells throughout the operational monitoring period beginning on 21 September 2018 and extending through 23 December 2019. The bulk EC data are plotted together with precipitation data from a weather station (NOAA Station ID US1AZPN0075) located approximately 3.3 miles northeast of the PTF wellfield.

Figures 2 through 8 show that decline in bulk EC values occurred on all four monitoring horizons following significant rain events throughout 2019, and that successive smaller rain events have a cumulative residual effect on bulk EC values. During dry periods between rain events, as residual soil moisture evaporates and soil temperatures rise, bulk EC values appear to stabilize or trend upwards. Figures 2 through 8 also show the following notable characteristics:

1. A downward shift of bulk EC values has occurred at a similar magnitude on every monitoring horizon (horizons 1 through 4) following significant precipitation events and successive smaller precipitation events. Review of the underlying data show that a similar magnitude downward shift occurs on every sensor pair in the monitoring system on every monitoring horizon. This type of shift indicates that changing conditions affected the entire monitoring system equally, and that the change is not related to upward migration of injected fluid, but rather with a change in the baseline conditions in the grounding network or reference electrodes used to process the individual bulk EC measurements.
2. The downward shift in bulk EC values detected on 21 November 2019 was preceded by two precipitation events (14 and 20 November 2019) that each produced greater than 1 inch of precipitation. Similar declines in bulk EC values were preceded by precipitation events on 25 September 2019, cumulative precipitation events between 31 January through 14 February 2019, and cumulative precipitation events between 5 and 19 October 2018. Similar to the 21 November precipitation event, each of the earlier precipitation events preceded system wide decline in bulk EC values.
3. The observed changes in bulk EC values are not spatially localized within the PTF wellfield, suggesting that there is not a localized pathway for vertical migration of solution.
4. The observed change in bulk EC values did not progress from the lowest level sensors on monitoring horizon 4, upward to horizons 3, 2, and 1 as would be expected if a vertical excursion of injected fluid had occurred. Rather, the change occurred at a similar magnitude, at the same time, at all sensor pairs on all monitoring horizons.

5. The resistivity values measured at monitoring horizon 4 remain higher than those measured in horizons 3, 2, and 1. This indicates that injected solution has not migrated upward through horizon 4 to reach horizons 3, 2, and 1. Had injected solution migrated vertically upward, it is anticipated that the lowest monitoring horizon, horizon 4, would have a lower resistivity than the overlying horizons instead of the higher values measured at horizon 4.
6. Additional rain events occurred following the initial exceedance detection on 21 November and during the period when confirmation monitoring was conducted.

It is important to note that precipitation falling on the surface at the PTF wellfield is not infiltrating to the bulk EC sensors located in the well bores to cause a decrease in bulk EC values. Rather, precipitation falling on the surface is affecting the equipment, grounding network, and reference electrode system located at ground surface which are used to collect the bulk EC data for processing the raw data.

Based on the data and information presented above, the bulk EC exceedances detected on 21 November 2019, and confirmed 26 November through 5 December 2019, were caused by the residual effects of successive precipitation events occurring prior to 21 November, which increased cumulative ambient soil moisture, decreased soil temperature, and resulted in other environmental changes affecting the surficial components of the bulk EC monitoring network, associated grounding network, and reference electrodes. These environmental changes had a systemwide affect, reducing all measured bulk EC values at all electrode pairs on all monitoring horizons by a similar magnitude, and resulted in the electrode pairs with the lowest ambient bulk EC values exceeding the horizon AL values.

## **Environmental Impacts**

The observed bulk EC exceedances described above are the result of ambient environmental changes at ground surface and are not the result of a vertical excursion of injected fluid. No adverse environmental impacts are known to have occurred as a result of the observed bulk EC exceedances.

## **Mitigation of Environmental Impacts**

No adverse environmental impacts are known to have occurred as a result of the observed bulk EC exceedances. Consequently, no mitigation of environmental impacts is required.

In accordance with Section 2.6.2.7 of the APP Permit, Florence Copper has increased the bulk EC monitoring frequency to three times per week. Florence Copper continues to actively monitor wellfield operational conditions and to actively maintain hydraulic control.

The August 2018 AL proposal included discussion of potential change in ambient bulk EC conditions arising from seasonal changes, instrument drift and other factors, and identified the potential need to revise the bulk EC ALs based on these factors. Haley & Aldrich has commenced statistical analysis of the bulk EC data for the purpose of re-calculating AL values to be included in a proposal for revised AL values in an application to amend APP No. P-106360.

## **Potential Errors in Measurement, Data Analysis, and Statistical Evaluation**

Haley & Aldrich has reviewed measurement, data analysis, and statistical analyses of the bulk EC data and has concluded that the observed bulk EC exceedances did not result from errors in measurement, data analysis, or statistical analysis.

## **Conclusion**

The bulk EC exceedances detected on 21 November 2019, and confirmed 26 November through 5 December 2019, are the result of natural changes in ambient environmental conditions at the PTF wellfield. The ambient environmental changes which resulted in the bulk EC exceedances were referenced in the August 2018 AL proposal describing the ambient bulk EC dataset, ambient data variability, and proposed method for AL calculation. The AL proposal specifically identified the sensitivity of the bulk EC monitoring method to precipitation events and provided direct examples of precipitation events that resulted in similar changes to ambient bulk EC values.

The confirmed bulk EC exceedances were caused by the cumulative effects of precipitation events occurring prior to 21 November 2019 which resulted in an increase of ambient soil moisture, decreased soil temperature, and resulted in other environmental changes affecting the surficial components of the bulk EC monitoring network, associated grounding network, and reference electrodes.

The exceedances are not the result of measurement error, data analysis error, or error in statistical analyses. The confirmed bulk EC exceedances are not the result of vertical excursion of injected fluid, no impacts to the environment are known to exist as a result of the bulk EC exceedances, and no environmental mitigation is required.

Haley & Aldrich has commenced statistical analysis of the bulk EC data for the purpose of re-calculating AL values and Florence Copper will propose revised AL values in an application to amend APP No. P-106360.

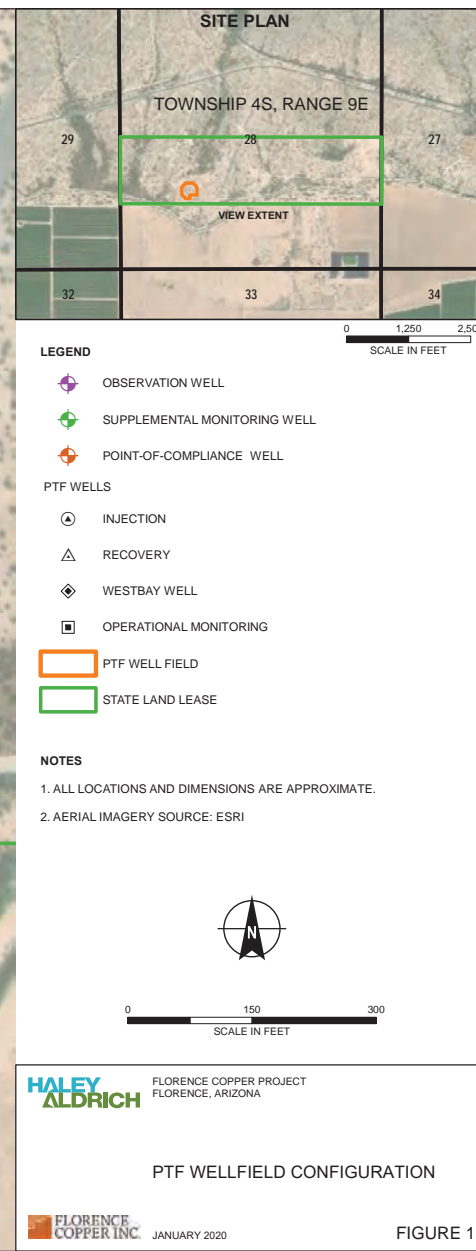
Please contact Mark Nicholls with any questions you may have regarding the content of this Technical Memorandum.

### **Enclosures:**

- Figure 1 – PTF Wellfield Configuration
- Figure 2 – Observation Well O-01: All Horizons
- Figure 3 – Observation Well O-02: All Horizons
- Figure 4 – Observation Well O-03: All Horizons
- Figure 5 – Observation Well O-04: All Horizons
- Figure 6 – Observation Well O-05: All Horizons
- Figure 7 – Observation Well O-06: All Horizons
- Figure 8 – Observation Well O-07: All Horizons

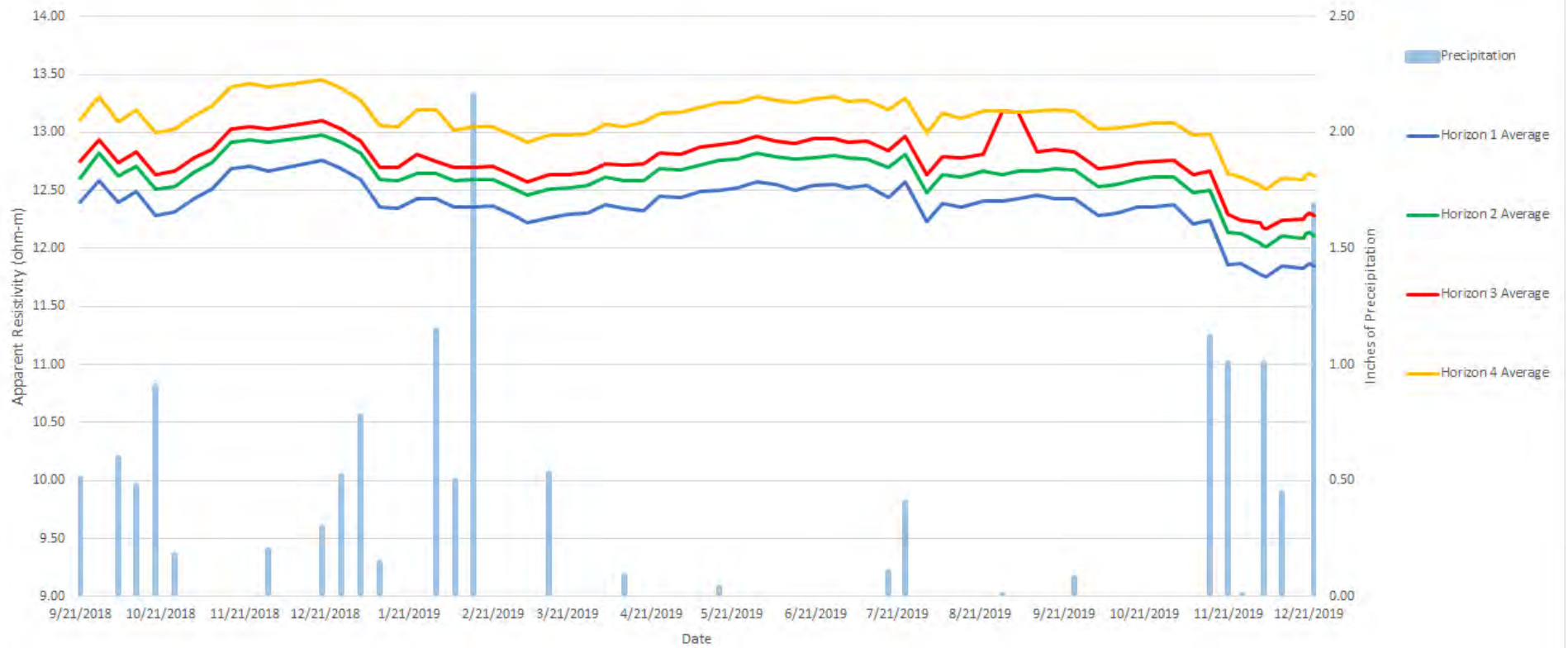
## FIGURES

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# Well O-01: All Horizons



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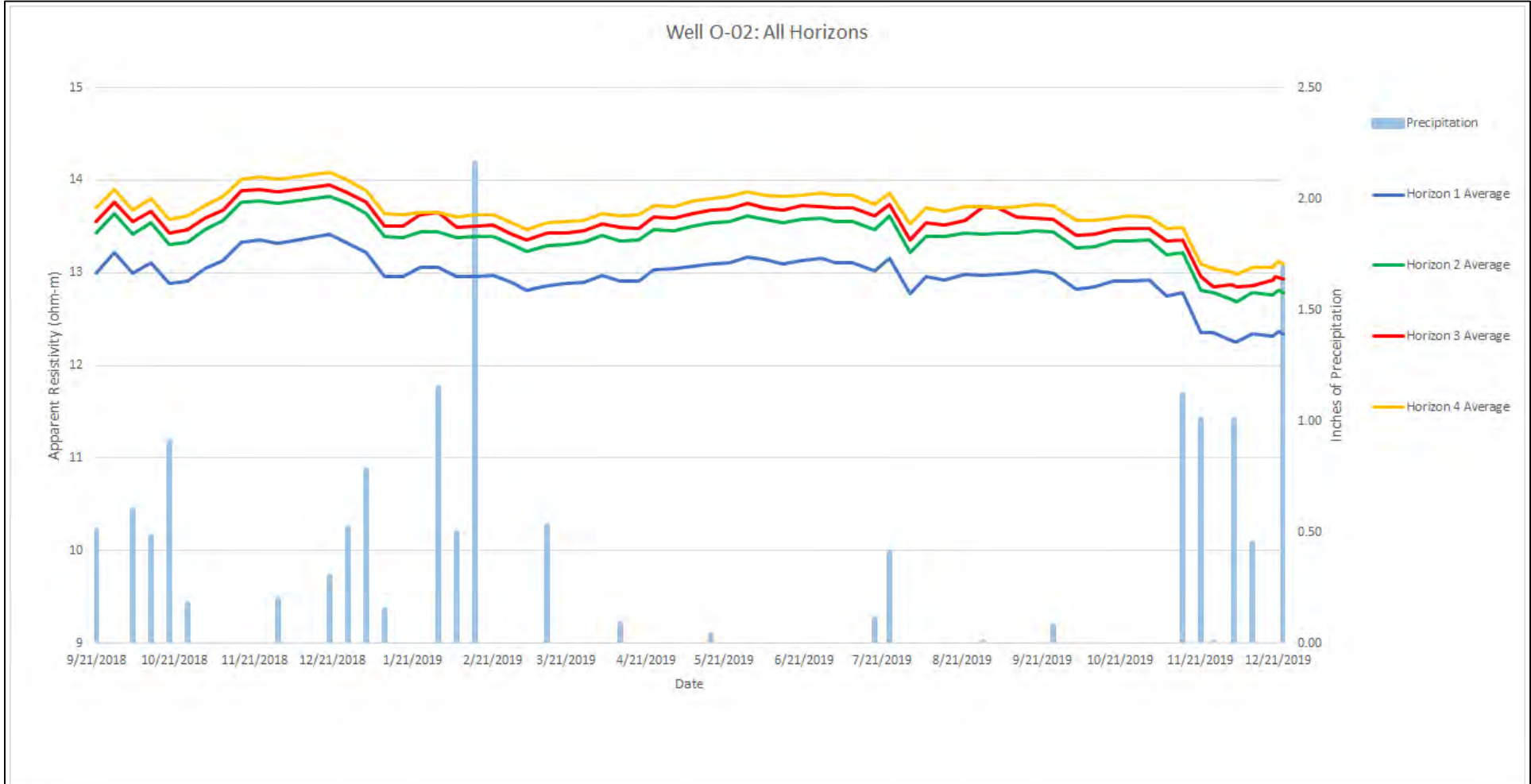
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OBSERVATION WELL O-01:  
ALL HORIZONS

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FIGURE 2



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PTF WELLFIELD  
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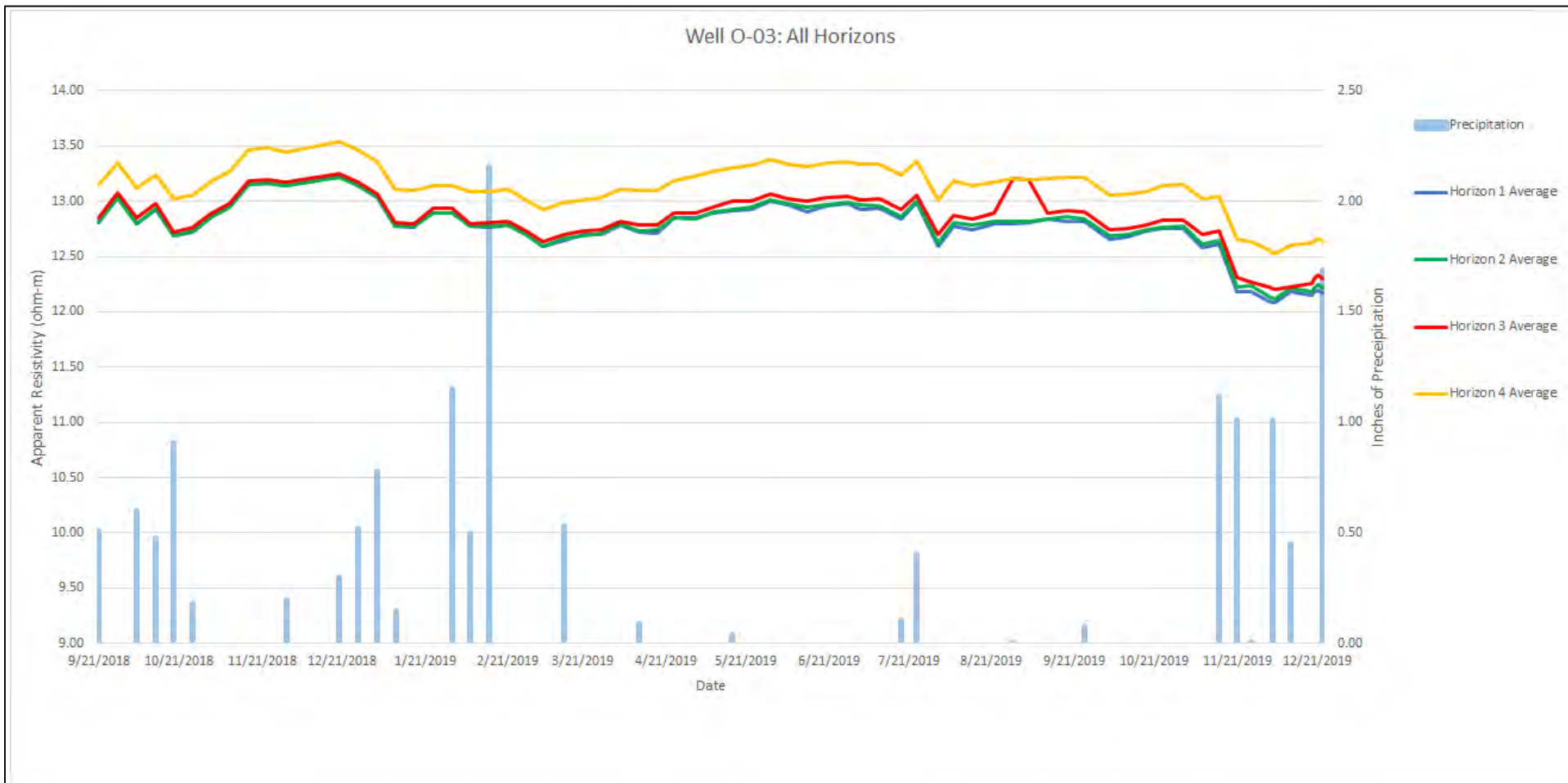
OBSERVATION WELL O-02:  
ALL HORIZONS

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FIGURE 3





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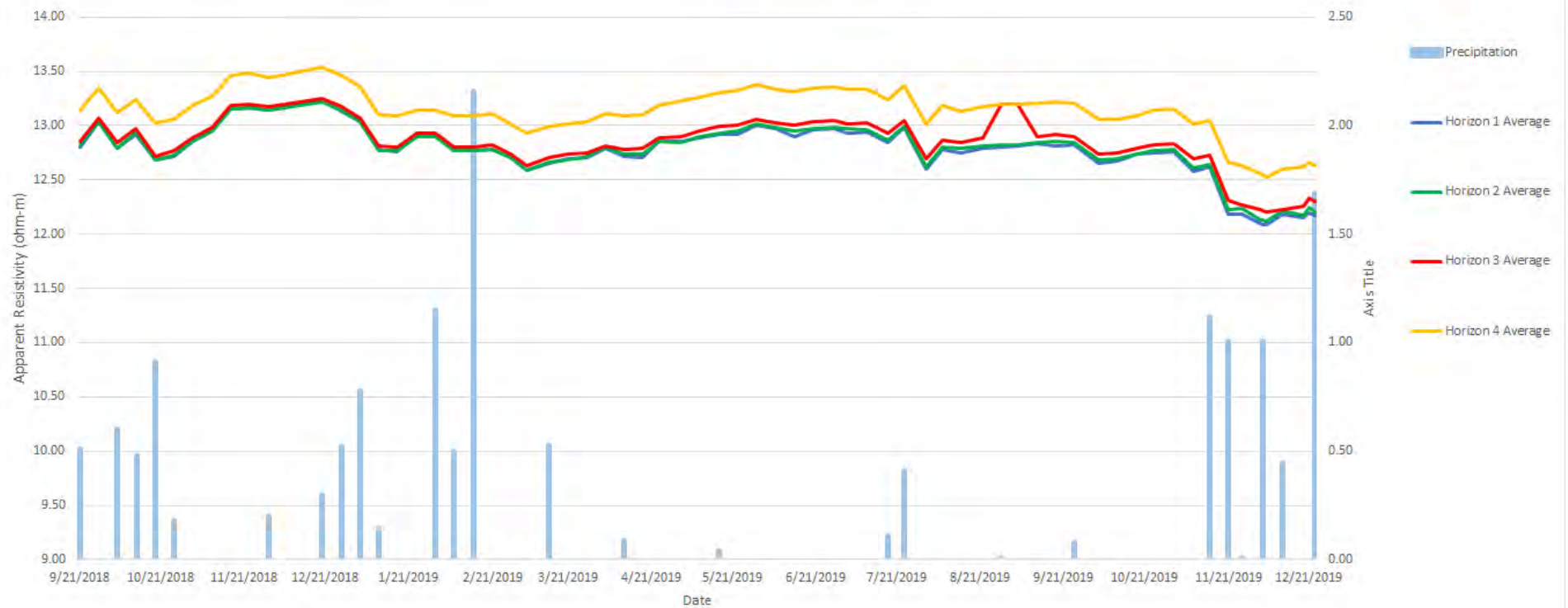
OBSERVATION WELL O-03:  
ALL HORIZONS

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FIGURE 4

Well O-04: All Horizons



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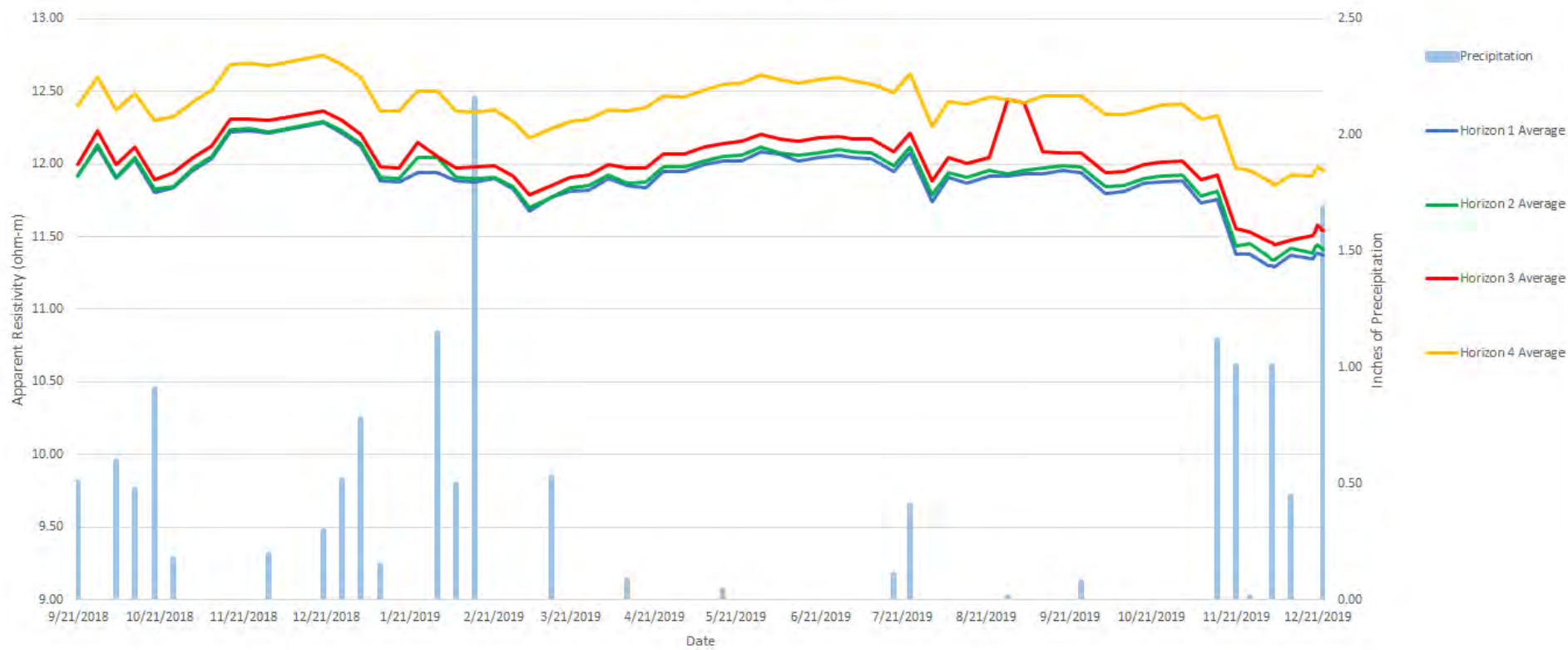
OBSERVATION WELL O-04:  
ALL HORIZONS

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FIGURE 5

Well O-05: All Horizons



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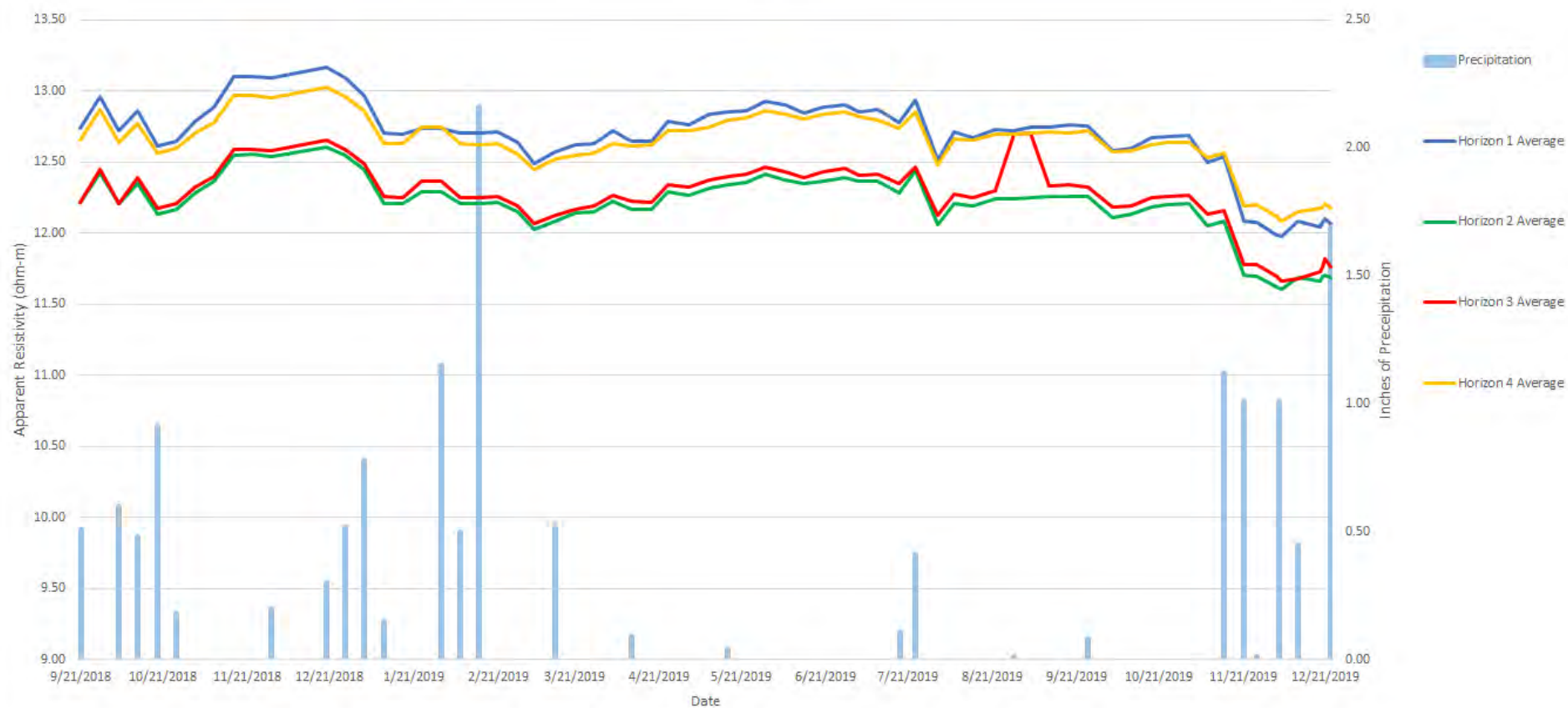
OBSERVATION WELL O-05:  
ALL HORIZONS

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FIGURE 6

Well O-06: All Horizons



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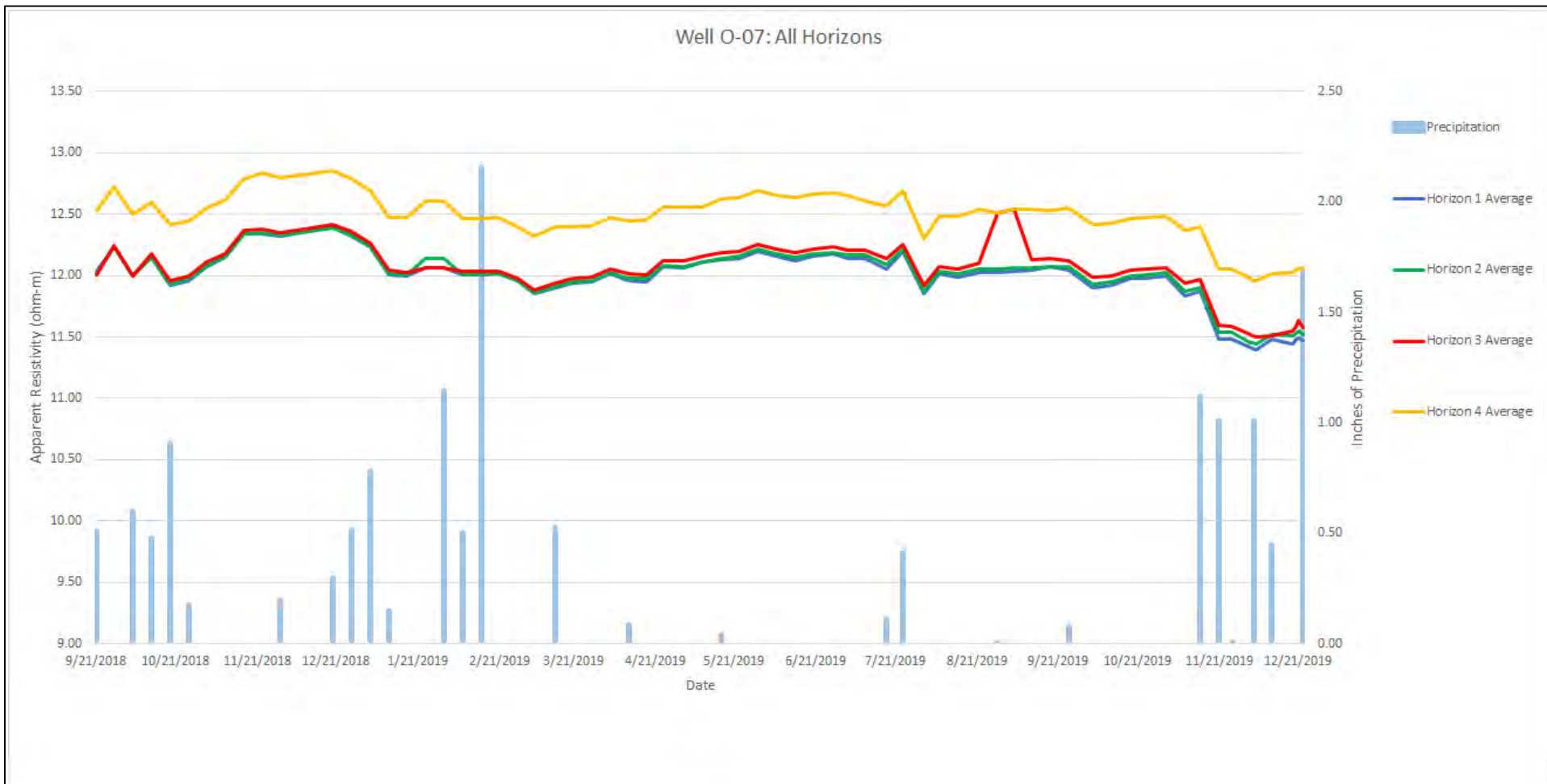
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OBSERVATION WELL O-06:  
ALL HORIZONS

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FIGURE 7



FLORENCE COPPER INC.  
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OBSERVATION WELL O-07:  
ALL HORIZONS



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FIGURE 8

## INSTRUCTIONS

This application is for an Individual Aquifer Protection Permit (APP) including an area-wide APP and Temporary APP, and for a Significant Amendment, Minor Amendment, or an Other Amendment to an Individual APP.

**ADEQ recommends scheduling a pre-application meeting to go over the various details of the program and the requirements for a complete application. See “Fee” section below for information on cost associated with the meeting.**

During the application process, you are encouraged to communicate with the ADEQ project team to resolve any issues that may arise during the process.

This document is divided into three main parts.

- 1) Instructions (Pages 1 - 4) - The instructions are intended to give you basic information regarding the application process, the permitting fee, definitions, how long the process may take, where to submit the application and how to withdraw an application. More detailed information can be obtained by referencing the specific rule citation listed with each application item. **Please do not submit the instructions with your application.**
- 2) Application - General Information (Pages 5 – 9) – This section includes basic Applicant and facility information; enter the information into the fillable form and indicate where any additional information is provided, if applicable.
- 3) Application - Technical Information (Pages 10 – 14) – This section requires information regarding the facility and specific ways the aquifer will be protected. Many of the items in this section are to be attached to the APP application as attachments or appendices. **ADEQ requests that you organize all the items and attachments using a Table of Contents that references the application form item number and the page number(s) where each item/attachment is located.**

### Professional Document Requirements

Please note that, except as exempted by A.R.S. § 32-144.A.7 (employees of mining companies), professional documents, such as reports, plans and specifications, are to be signed by an Arizona registered engineer or geologist (A.R.S. § 32-125). Cost estimates prepared by an engineer, design documents and engineering analysis must be signed and sealed by an Arizona Registered Professional Engineer, and must not include labels such as “Draft”, “Preliminary”, or “Not for Construction” per A.R.S. § 32-101(B)(10 and 11) and 32-125.



## Process

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**Optional:** Applicant is encouraged to meet with ADEQ staff for a pre-application meeting to discuss the project and the requirements for a complete application. This is an optional step, but is **highly recommended**. Request a pre-application meeting by completing the Request Form available at [http://static.azdeq.gov/forms/app\\_preapmtg.pdf](http://static.azdeq.gov/forms/app_preapmtg.pdf) and submitting the form to Naveen Savarirayan at [Savarirayan.Naveen@azdeq.gov](mailto:Savarirayan.Naveen@azdeq.gov). If you have questions, call the permit line at 602-771-4999.

- 1) Applicant submits the application as follows:
    - a. Provide two comb bound copies of the application form and all attachments: Please provide at least one comb or spiral bound copy; the other copy may be in a 3-ring binder. Also, it may be helpful to provide a third copy if the project team includes three ADEQ staff; please discuss this with the project manager prior to application submittal.
    - b. Please include **one electronic copy** of the application form and all attachments, e.g. flash drive, CD or other method. Please separate the financial assurance documents from the other application sections.
    - c. Please provide a cover letter that provides a general overview of the project including a brief description of the business or activity, a list of discharging facilities, and a description of any treatment and/or disposal related to the discharging facilities. In the case of an amendment to an existing permit, please also provide a description of the amendment.
    - d. **Please complete all items on the application form. If an item is not applicable write “NA” and provide rationale for why the item is not required. A pre-application meeting is recommended to discuss what will be required for a complete application (see “Optional” process step above).** Failure to complete all items will result in an application that is administratively incomplete (see Step 2 below).
    - e. Please include a Table of Contents for the Technical Information that references the application form item number, and lists Tables, Figures, Drawings, and Appendices.
    - f. Please include Labels/Tabs in the bound application copies that correspond to the application form item number and the Table of Contents.
  - 2) ADEQ reviews the application for Administrative Completeness (A.A.C. R18-1-503), and either:
    - a. Issues a letter indicating the application is Administratively Complete and begins Substantive Review, or
    - b. Issues a letter listing required additional information for the application to be determined administratively complete. The Applicant must provide all items on the application form. If an item is not applicable, adequate rationale must be provided. In response to an ADEQ letter requesting additional information,
      - i. Applicant provides additional information, or
      - ii. Applicant relies on information already provided. ADEQ may elect to initiate the permit denial process.
  - 3) ADEQ conducts the Substantive Review (A.A.C. R18-1-504) of the application for technical content and to ensure that your application contains all required technical information necessary to issue a permit to you.
    - a. If the application meets requirements, ADEQ begins drafting the permit.
    - b. If additional information is needed, ADEQ sends a letter requesting the information. In response,
      - i. Applicant provides requested information and ADEQ continues/completes the Substantive Review, or
      - ii. Applicant relies on information already provided. ADEQ may elect to initiate the permit denial process.
- Optional:** Applicant is encouraged to participate in meetings or conference calls with the ADEQ project team to resolve any issues that may arise during the Substantive Review. This is optional, but **highly recommended**.
- 4) ADEQ initiates Internal/External review of the draft permit and executive summary.
  - 5) ADEQ publishes notice of the 30-day public participation period, only for a new permit or significant amendment. Other amendments do not have a 30-day public participation period.
  - 6) ADEQ holds a Public hearing, if needed, only for a new permit or significant amendment. ADEQ responds in writing to all comments received during the comment period.
  - 7) ADEQ sends a Decision to Grant the permit.

- 8) ADEQ sends the final bill to the Applicant.
- 9) Applicant pays the bill.
- 10) ADEQ issues and mails the permit.

## **Fees (A.A.C. R18-14-101 et. seq.)**

The permit team assigned to your project will bill at a rate of \$122.00 per hour up to a maximum fee of \$200,000 for a new permit. Maximum fee amounts for permit amendments are provided in the fee rule at A.A.C. R18-14-102.

ADEQ recommends scheduling a pre-application meeting to go over the various details of the program and the requirements for a complete application. The first hour of the pre-application meeting is free for the project manager's time. The other members of the project team (engineer, hydrogeologist, and financial reviewer), will bill for the pre-application meeting time.

ADEQ will provide monthly invoices for the interim permit fees. If full payment is not received within the prescribed timeframe on the invoice, ADEQ will consider the nonpayment as "willful neglect" pursuant to A.R.S. § 49-113(B). As provided by A.R.S. § 49-113(B), ADEQ will, in addition to any applicable interest rate, collect an additional five percent penalty of up to twenty five percent of the amount due for each month or fraction of a month the amount is past due. ADEQ may also refer this matter to the Office of the Attorney General for appropriate legal action. ADEQ will also cease work on your application and initiate a denial of the pending application at that time.

## **Definitions**

The statutes (A.R.S. 49-201) and rules (A.A.C. R18-9-101) provide the majority of definitions for terms used in the aquifer protection program. The list below is provided for convenience and to clarify terms used in this application form that are not defined elsewhere. Additional statutory and regulatory definitions/requirements are available here:

<https://www.azleg.gov/ARStitle/> and <https://azsos.gov/>

**Applicant/Permittee:** The *person* (see definition of person below) who is applying for the permit is the Applicant; this is the same *person* who will become the Permittee once the permit is issued and **will be responsible** for compliance with the terms and conditions of the permit, rules and statutes, and all financial assurance requirements, monitoring, reporting and contingency requirements, corrective actions and compliance actions as a result of permit violations. **Typically, the company or government entity is the Applicant/Permittee, and will designate an authorized person to sign the certification statement on the application.**

NOTE: The Applicant must be an entity authorized to do business in the State of Arizona. The permit must be issued to either a (1) Corporation (2) Limited Liability Company (3) Partnership [includes Limited Liability Partnership or Limited Liability Limited Partnership] or (4) an Individual or Sole Proprietorship authorized to do business in Arizona. The Applicant should confirm their status as follows prior to submitting an application: Arizona Corporation Commission (for corporations and limited liability companies); Secretary of State (for partnerships, limited partnerships, limited liability partnerships, and limited liability limited partnerships); Requirements in Arizona Revised Statutes Title 41, Chapter 6 Administrative Procedure, Article 7.2 - Licensing Eligibility concerning citizenship and residency (for individuals).

**Authorized Agent:** The licensing time frame rule provides the option for the Applicant's agent, authorized by the Applicant, to receive all notices issued by the Department under Article 5, Title 18, Chapter 1 (A.A.C. R18-1-503(A)(3)).

**Discharging facilities:** Defined in A.R.S. §49-241 as: surface impoundments, including holding, storage, settling, treatment or disposal pits, ponds and lagoons; solid waste disposal facilities, injection wells; land treatment facilities; facilities that add a pollutant to a salt dome formation, salt bed formation, dry well or underground cave or mine; mine tailings piles and ponds; mine leaching operations;



underground water storage facilities; sewage treatment facilities including on-site wastewater treatment facilities; wetlands designed and constructed to treat municipal and domestic wastewater for underground storage.

**Discharge:**

Defined in A.R.S §49-201(12): the direct or indirect addition of any pollutant to the waters of the state from a facility. For purposes of the aquifer protection permit program prescribed by article 3 of this chapter, discharge means the addition of a pollutant from a facility either directly to an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer.

**Person:**

Defined in A.A.C. R18-9-A101(29): “Person” means an individual, employee, officer, managing body, trust, firm, joint stock company, consortium, public or private corporation, including a government corporation, partnership, association or state, a political subdivision of this state, a commission, the United States government or any federal facility, interstate body or other entity. A.R.S. § 49-201(26). For the purposes of permitting a sewage treatment facility under Article 2 of this Chapter, person does not include a homeowner’s association.

## **Licensing Timeframes**

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Licensing Time Frames (LTF) are specified by Arizona Department of Environmental Quality in A.A.C. R18-1-525, which limits the number of **business days** ADEQ can review your project without a penalty. LTF for an individual permit automatically defaults to an “Individual Permit (no public hearing)”. Likewise, the LTF for a significant amendment automatically defaults to an “Individual Permit Significant Amendment (no public hearing)”. ADEQ may reassign the license time if a public hearing is required or if the application is deemed “complex” in accordance with A.A.C. R18-1-501(9).

License Type	Administrative Completeness Review (business days)	Substantive Review (business days)	Overall Time Frame (business days)
Individual Permit (no public hearing)	35	186	221
Individual Permit (with public hearing)	35	231	266
Complex Individual Permit (no public hearing)	35	249	284
Complex Individual Permit (with public hearing)	35	294	329
Individual Permit Significant Amendment (no public hearing)	35	186	221
Individual Permit Significant Amendment (with public hearing)	35	294	329
Individual Permit Other Amendment	35	100	135

## **Where to Submit the Application**

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Arizona Department of Environmental Quality  
Groundwater Protection Value Stream  
Attn: LTF Application Clerk  
1110 West Washington Street, Mail Code 5415B-3  
Phoenix, Arizona 85007

## **Withdrawing your Application**

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The Applicant may withdraw an application at any time during the application process in accordance with A.A.C. R18-1-517. You may withdraw your application by submitting a written request to the reviewer assigned to your project. Withdrawing your application causes the LTF to cease. A final bill will be assessed at the time of withdrawal.

## GENERAL INFORMATION

**1. Application to obtain [A.R.S. 49-241]:**

New APP Amendment

Amendment to a current APP Inventory No. P-106360 LTF No. 78815

Description of all amendment requests and justification included in Report Section/Appendix 1

A copy of the current permit, annotated with any inconsistencies between the permit requirements and the existing facilities or operation, included in Report Section/Appendix N/A

NOTE: ADEQ can provide the permit in WORD file format upon request.

**2. Applicant/Permittee Name [A.A.C. R18-1-503(1)] (see Definitions):**

Company/Government/Entity Name: (RESPONSIBLE FOR ALL PERMIT CONDITIONS)  
Florence Copper Inc.

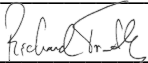
**3. Applicant/Permittee - Certification Statement [A.A.C. R18-9-A201(B)(7)]:**

I certify under penalty of law that this Aquifer Protection Permit application and all attachments were prepared under my direction or authorization and all information is, to the best of my knowledge, true, accurate and complete. I also certify that the APP discharging facilities described in this form is or will be designed, constructed, operated, and/or closed in accordance with the terms and conditions the Aquifer Protection Permit and applicable requirements of Arizona Revised Statutes Title 49, Chapter 2, and Arizona Administrative Code Title 18, Chapter 9 regarding aquifer protection permits. I am aware that there are significant penalties for submitting false information, including permit revocation as wells as the possibility of fine and imprisonment for knowing violations.

Authorized person signature:

Name: Richard Tremblay

Title: Vice President Operations

Signature 

Date: 02/27/2020

**4. Applicant/Permittee Address**

Mailing Address: 1575 W Hunt Highway, Florence, Arizona, 85132

Billing Address: 1575 W Hunt Highway, Florence, Arizona, 85132

Email Address: RTremblay@tasekomines.com

Phone Number: (520) 374-3984

**5. Authorized Agent [A.A.C. R18-1-503(3)] (Optional, see Definitions):**

Name: N/A  
Firm Name N/A  
Mailing Address: N/A  
Email Address: N/A  
Phone Number: N/A

**6. Facility Information [A.A.C. R18-1-503(2), A.A.C. R18-9-201(B)(1)]**

Name: Florence Copper Inc.  
Address: 1575 W Hunt Highway, Florence, Arizona, 85132  
County: Pinal County  
Latitude: 33 ° 03 ' 00 " Longitude: 111 ° 25 ' 00 "  
Coordinate System used for Latitude and Longitude: ☐ NAD27 ☒ NAD83  
Township 4S Range 9E Section: 26, 27, 28, 33, 34, and 35  
Driving directions from a major intersection: 2 miles west of the intersection of Hwy 79 and W Hunt Hwy

**7. Facility Notices of Violation, Consent Orders or Compliance Orders in the last 2 years [A.A.C. R18-9-A202(A)(11), included in Report Section/Appendix N/A**

**8. Facility Owner**

Company/Government/Entity Name: Florence Copper Inc.  
Contact Person Name Richard Tremblay, Vice President Operations  
Mailing Address: 1575 W Hunt Highway, Florence, Arizona, 85132  
Email Address: RTremblay@tasekomines.com  
Phone Number: (520) 374-3984

**9. Contact Person for Facility Emergencies [A.A.C. R18-9-A202(A)(11)]**

Name: Richard Tremblay Title: Vice President Operations  
Mailing Address: 1575 W Hunt Highway, Florence, Arizona, 85132  
Email Address: RTremblay@tasekomines.com  
Phone Numbers landline: (520) 374-3984 mobile phone: (778) 373-4573

**10. Contact Person(s) for Permit Compliance Schedule Items Notifications (Optional)**

ADEQ has developed a tool to track compliance schedule items (CSIs) 30 and 5 days before they are due, and 5 days after they become overdue. The person(s) identified, will receive email notifications in addition to the Applicant/Permittee.

Name(s): Richard Tremblay

Email Address(es): RTremblay@tasekomines.com

**11. Landowner**

Company/Government/Entity Name: Florence Copper Inc./Arizona State Land Department

Contact Person Name Richard Tremblay

Mailing Address: 1575 W Hunt Highway, Florence, Arizona, 85132

Email Address: RTremblay@tasekomines.com

Phone Number: (520) 374-3984

160 acres of the facility is located on land owned by the State of Arizona and is leased to Florence Copper under Mineral Lease (No. 11-026500), which identifies Florence Copper as the lessee, and is included in as Exhibit 1-1.

**12. Expected operational life of the Facility [A.A.C. R18-9-A201(B)(1)]**

(Start date) December 2018 (Close Date) December 2020

**13. Facility discharge or influent per day in gallons [A.A.C. R18-14-104, A.R.S. 49-242]: 432,000 (gallons)**

**14. All other federal or state environmental permits issued to the Applicant for the Facility or site, including type and identification number [A.A.C. R18-9-A201(B)(1)], included in Report Section/Appendix 1**

**15. Are you required to file a certificate of disclosure according to A.R.S. §49-109?**

☐ Yes, attached in Report Section/Appendix \_\_\_\_\_

☒ No, not required

**16. Evidence that the facility complies with applicable municipal or county zoning ordinances, codes and regulations [A.A.C. R18-9-A201(B)(3)], included in Report Section/Appendix N/A**

**17. Evidence of technical capability to carry out the terms of the permit (design, construction, and operation) including licenses, certifications, training, and work experience [A.A.C. R18-9-A202(B)] Attached in Report Section/Appendix N/A**

## Cost Estimates and Financial Assurance Demonstration [A.A.C. R18-9-A201(B)(5) and R18-9-A203]

Is this application for:

1) A new permit? YES\_\_\_ NO X

2) Significant Amendment? YES\_\_\_ NO X

NOTE: Updated cost estimates may be required for a significant amendment as defined by rule if required to address incremental changes in the cost estimate that result from the significant amendment, A.R.S. § 49-243(N)(2)(b).

3) Other Amendment for permit transfer? YES\_\_\_ NO X

4) Cost Estimate/Financial Demonstration update? YES\_\_\_ NO X

5) Estimate/Financial Demonstration at the direction of ADEQ? YES\_\_\_ NO X

6) A permit that has not been amended in the last five years? YES\_\_\_ NO X

**If you answered “YES” to ANY of the above questions, provide updated cost estimates and a financial assurance demonstration. If you answered “NO” to ALL of the above questions, skip this section and continue to the “Technical Information” Section.**

### 18. Cost Estimates provided in Report Section/Appendix N/A

Closure costs and a financial demonstration are required even if the Applicant does not intend to close the facility in the near future. The closure and post-closure cost estimates must be based on the closure and post-closure plan/strategy (required by Application Item 32, below). Please see checklists for closure plans/strategies and cost estimate on the ADEQ website: <http://www.azdeq.gov/node/542>

NOTE: Cost estimates must be derived by an engineer, controller or accountant. Except as exempted by A.R.S. § 32-144.A.7 (employees of mining companies), professional documents, such as reports, plans and specifications, are to be signed by an Arizona registered engineer or geologist (A.R.S. § 32-125). Cost estimates prepared by an engineer, design documents and engineering analysis must be signed and sealed by an Arizona Registered Professional Engineer, and must not include labels such as “Draft”, “Preliminary”, or “Not for Construction” per A.R.S. § 32-101(B)(10 and 11) and 32-125.

Provide the cost estimates in the spaces provided below and attach supporting documentation for the cost estimates.

- |                 |               |
|-----------------|---------------|
| a. Construction | \$ <u>N/A</u> |
| b. Operation    | \$ <u>N/A</u> |
| c. Maintenance  | \$ <u>N/A</u> |
| d. Closure      | \$ <u>N/A</u> |
| e. Post-Closure | \$ <u>N/A</u> |

**19. Financial Assurance Demonstration for either (a) non-government or (b) government:**

Indicate which financial assurance demonstration will be provided to cover the cost of Closure and Post-closure. It is preferable to wait for ADEQ to review and approve the cost estimates prior to submitting the finalized financial demonstration required by Item 19; simply indicating the type of demonstration is adequate for submittal of the application. Please see the ADEQ website for financial assurance mechanism templates and instructions at <http://azdeq.gov/financial-responsibility-options-apps>

Provide information based on whether the Applicant/Permittee is a non-government or government entity:

- a. A non-government entity:
  - i. Financial Assurance Mechanism selected N/A
  - ii. Details of any financial mechanism held by another government agency for the purpose of closure and post-closure activities described in the closure plan/strategy, provided in Report Section/Appendix N/A
  - iii. A letter on Company letterhead signed by the Chief Financial Officer, as required by A.A.C. R18-9-A203, is attached in Report Section/Appendix N/A
- b. A government entity:
  - i. A statement that indicates how the entity is capable of meeting the costs listed in the Cost Estimate section above is included in Report Section/Appendix N/A

# **APPLICATION TECHNICAL INFORMATION**

## **20. Facility description, including the following information, is provided**

**in Report Section/Appendix N/A**

- a. A general description of what the facility does.
- b. When operations began or are estimated to begin.
- c. A general description of the facility process as it relates to the discharge, including:
  - i. Operating, proposed and closed discharging facilities, or activities that discharge,
  - ii. source(s) of wastewaters/waste, and
  - iii. facility or location where the wastewater/waste is discharged.

NOTE: see the Definitions section for “discharging facility” and “discharge”

## **21. Process flow diagram that shows the activity producing the discharge (e.g. wastewater treatment, cooling, manufacturing), including the pertinent elements that affect the quality of the discharge, is included as Report Section/Appendix N/A**

## **22. List the discharging facilities and activities that discharge in the table below. Indicate whether they are currently operating/existing, are proposed as new, or are to be closed as part of this permit application, and provide their location [A.R.S. 49-241]. Additional facilities listed in Report Section/Appendix N/A**

Facility or Activity Name (e.g. Evaporation Pond 1)	Existing, Proposed or to be closed	Latitude	Longitude
In Situ Area Well Block	Existing	<u>33</u> ° <u>03</u> ' <u>1.39</u> ”	<u>111</u> ° <u>26</u> ' <u>4.69</u> ”
Process Water impoundment	Existing	<u>33</u> ° <u>03</u> ' <u>8.67</u> ”	<u>111</u> ° <u>25</u> ' <u>22.18</u> ”
Run-off Pond	Existing	<u>33</u> ° <u>03</u> ' <u>4.66</u> ”	<u>111</u> ° <u>25</u> ' <u>22.6</u> ”

## **23. Map(s) [A.A.C. R18-9-A202(A)(1)], included in Report Section/Appendix N/A**

Include the following:

- 1) North arrow
- 2) Scale
- 3) Topography with sufficient resolution and legible elevations of contours for the facility
- 4) Facility location
- 5) Property line(s) and use of adjacent property
- 6) Overlay of State or Federal land
- 7) All known water wells within 1/2 mile of property boundary
- 8) Labeled with ADWR Well Number, latitude and longitude
- 9) Provide the uses and well construction details of the water wells, if known, water level elevations in the wells, and highlight/identify the nearest downgradient well. Tabulation of this data to prevent excessive labeling on the site plan itself is preferred.)

**24. Site Plan [A.A.C. R18-9-A202(A)(2), (4) and (8), A.R.S. 49-244], included in Report Section/Appendix N/A**

Include the following:

- 1) North arrow
- 2) Scale
- 3) Property lines
- 4) Structures
- 5) Water wells
- 6) Injection Wells
- 7) Drywells and their uses
- 8) Topography
- 9) All known borings
- 10) 100-year floodplain (FEMA Flood Insurance Rate Map (FIRM) 100-year showing floodplain boundary preferred)
- 11) Surface water bodies
- 12) Surface water flow direction(s)
- 13) Groundwater flow direction(s)
- 14) Pollutant Management Area (PMA)  
NOTE: In cases where the site is very large, there are multiple PMAs or there is an excessive amount of information that would make the site plan indecipherable, it may be clearer to provide site plans for discrete areas or provide a separate site plan with the PMA, DIA and POC wells.
- 15) Discharge Impact Area (DIA).

Also, include the following with the latitude and longitude:

- 1) Discharging facilities/discharge locations and existing and proposed Point of Compliance (POC) locations and/or wells
- 2) Tabulation of this data to prevent excessive labeling on the site plan itself is preferred.
  - a. ***For open pit mine facilities***, show the delineation of the passive containment capture zone (PCCZ) and the open pit boundary, if relying on this for BADCT.
  - b. ***For Sewage Treatment Facilities*** include effluent sampling and effluent discharge location(s) with latitude and longitude, and setback distance(s) measured from the treatment and disposal components within the sewage treatment facility to the nearest property line of an adjacent dwelling, workplace, or private property.



- Is this application for a Sewage Treatment Facility (STF)?      YES\_\_\_ NO X
- If you answered “YES” to the question above, skip items #25 through 27, and proceed to item #28.

**25. Characterization of discharge [A.A.C. R18-9-A202(A)(4)], included in Report Section/Appendix N/A**

For all non-STF facilities: provide characterization of discharge to include a summary of known past and proposed facility discharge activities. Provide estimated discharge characteristics or results of actual discharge characterization, and quantities/flow rate. Tabulated data is preferred with laboratory results included as an appendix.

**Professional Document Requirements**

Please note that, except as exempted by A.R.S. § 32-144.A.7 (employees of mining companies), professional documents, such as reports, plans and specifications, are to be signed by an Arizona registered engineer or geologist (A.R.S. § 32-125). Cost estimates prepared by an engineer, design documents and engineering analysis must be signed and sealed by an Arizona Registered Professional Engineer, and must not include labels such as “Draft”, “Preliminary”, or “Not for Construction” per A.R.S. § 32-101(B)(10 and 11) and 32-125.

The following application sections are typically considered professional documents: Application Items 26 through 32 (Design Documents, BADCT Description, Hydrogeologic Study, Demonstration of Compliance with AWQS at POC, Monitoring Proposal, Contingency Plan, and Closure/Post-closure Plan/Strategy) and Item 35, 36 and 39 for Sewage Treatment Facilities (Design Report, Engineering Plans and Specifications, and Sludge Treatment facilities).

**26. Design Documents [A.A.C. R18-9-A202(A)(3)], included in Report Section/Appendix N/A**

For all non-STF facilities: provide facility design documents, proposed or as-built, indicating the configuration or other engineered elements of the facility affecting discharge. Drawings must be legible with readable font sizes and include sufficient detail to indicate the key design features. When formal as-built plans are not available, provide documentation sufficient to allow evaluation of those elements of the facility affecting discharge, following the demonstration requirements of A.R.S. 49-243(B). Provide construction specifications and a quality control/quality assurance plan for new facilities.

**27. Best Available Demonstrated Control Technology “BADCT” Description<sup>5</sup> [A.A.C. R18-9-A202(A)(5)], included in Report Section/Appendix N/A**

For all non-STF facilities: provide design information pertaining to all discharging facilities including all calculations/analyses to demonstrate that all facilities are designed per BADCT guidance or rule.

Examples include: facility sizing, stability analyses, water balance, freeboard calculations, liner leakage rate calculations

For further specifics, please see the Mining and Industrial APP Engineering Substantive Checklist on the ADEQ website: <http://www.azdeq.gov/node/542>.

**28. Hydrogeologic Study or justification that a limited study or no study is required [A.A.C. R18-9-A202(A)(8)], included in Report Section/Appendix N/A**

For further specifics, please see the Hydrology Substantive Review Checklist on the ADEQ website: <http://www.azdeq.gov/node/542>.

**29. Demonstration of Compliance with AWQS at POCs [A.A.C. R18-9-A202(A)(6)], included in Report Section/Appendix N/A**

For further specifics, please see the Hydrology Substantive Review Checklist on the ADEQ website: <http://www.azdeq.gov/node/542>.

**30. Monitoring Proposal [A.A.C. R18-9-A202(A)(9)], included in Report Section/Appendix 2**

A detailed proposal indicating the alert levels, discharge limitations, monitoring requirements, compliance schedules, and temporary cessation or plans that the Applicant will use to satisfy the requirements of A.R.S. Title 49, Chapter 2, Article 3 and Articles 1 and 2 of Chapter 9. Include as applicable, discharge and groundwater monitoring and operational/inspections. Indicate sampling point(s) with latitude and longitude (e.g. effluent, discharge, groundwater monitoring or other sampling points)

**31. Contingency Plan [A.A.C. R18-9-A202(A)(7) and R18-9-A204], included in Report Section/Appendix N/A**

**32. Closure and Post-closure Plan/Strategy [A.A.C. R18-9-A202(A)(10)], included in Report Section/Appendix N/A**

For further specifics, please see the Closure and Post-closure Plan/Strategy and Cost Estimate Checklist on the ADEQ website <http://www.azdeq.gov/node/542>

**Sewage Treatment Facility Applications ONLY (Items 33 through 39)**

**33. For Sewage Treatment Facilities (STFs), indicate the effluent disposal method(s) to be utilized and the disposal capacity for each method [A.A.C. R18-9-B202]:**

<b>Disposal Method</b>	<b>Flow capacity (gal/day)</b>
<input type="checkbox"/> Beneficial reuse under a Recycled Water Permit	N/A
<input type="checkbox"/> Surface impoundment primarily for evaporation	N/A
<input type="checkbox"/> Surface impoundment primarily for recharge to groundwater	N/A
<input type="checkbox"/> Discharge to a Water of the U.S. under a Clean Water Act Permit (NPDES/AZPDES)	N/A
<input type="checkbox"/> Vadose zone injection wells	N/A
<input type="checkbox"/> Injection wells directly into groundwater	N/A
<input type="checkbox"/> Land application for disposal; not reuse	N/A
<input type="checkbox"/> Other, describe: _____	N/A

- 34. Documentation that the Sewage Treatment Facility is in conformance with the Area-wide 208 Quality Management Plan for Sewage Treatment Facilities [A.A.C. R18-9-A201(B)(6)].**  
**Included in Report Section/Appendix**   N/A

For further information on the 208 requirements, please see the ADEQ website <http://www.azdeq.gov/208-review>

- 35. Sewage Treatment Facility Design Report [A.A.C. R18-9-B202], attached**  
**in Report Section/Appendix**   N/A

Include information pertaining to all discharging facilities including all calculations/analysis to demonstrate that all facilities are designed per BADCT treatment performance requirements in rule. In addition, include facility sizing, stability analyses, water balance, freeboard calculations, and liner leakage rate calculations.

An Arizona registered engineer shall seal the design report.

For further specifics please see the WWTP engineering review checklist on the ADEQ website <http://www.azdeq.gov/node/542>.

- 36. Sewage Treatment Facility Engineering Plans and Specifications [A.A.C. R18-9-B203], included**  
**in Report Section/Appendix**   N/A

The documents may include manufacturer's specifications and cut sheets and shall be sealed by an Arizona registered engineer.

- 37. Sewage Treatment Facility Recycled Water classification [A.A.C. R18-11, Article 3]:**   N/A

- 38. Sewage Treatment Facility Set-back map [A.A.C. R18-9-B201(I)], included**  
**in Report Section/Appendix**   N/A

- 39. Sewage Treatment Facility sludge treatment and disposal description [A.A.C. R18-9-B202]. Included**  
**in Report Section/Appendix**   N/A

If treatment or disposal at the facility includes discharging facilities, include the Design and BADCT information required by Items 26 and 27 above. Example of a discharging facility is a sludge drying bed.

**END OF APPLICATION FORM**

## **APPENDIX 1**

### **(Item 1) Amendment Description**

# Application to Amend Aquifer Protection Permit No. P-106360 Florence Copper Project



## Appendix 1: Amendment Description

### 1.1 INTRODUCTION

Florence Copper Inc. (Florence Copper) has requested amendment of Aquifer Protection Permit (APP) No. P-106360 under the “Other” permit amendment process authorized by Arizona Administrative Code (A.A.C.) R18-9-A211(D).

The purpose of this amendment is to revise the bulk electrical conductivity (EC) alert levels (AL) currently included in APP No. P-106360. The AL revision is warranted due to the natural variability of measured bulk EC values that extend beyond the observed range of the initial ambient bulk EC dataset. Florence Copper proposes herein to calculate new ALs using the same procedure used to establish the current ALs using the full range of bulk EC data to capture variability driven by changing natural conditions.

The requested amendment qualifies as an Other Amendment in accordance with A.A.C. R18-9-A211(D) because the requested change does not meet the criteria specified under A.A.C. R18-9-A211(B) or (C) which define Significant and Minor Amendments, respectively. A.A.C. R18-9-A211(D) states that the Director may issue an Other Amendment if the amendment does not meet the criteria for a Significant or Minor Amendment. The applicability of criteria pertaining to a Significant or Minor amendment are summarized in Tables 1 and 2, respectively.

**Table 1. Significant Amendment Permit Application Criteria**

<b>Amendment Type</b>	<b>A.A.C. Reference</b>	<b>Description of Criterion</b>	<b>Applies to the Proposed Amendment</b>	<b>Notes</b>
Significant Amendment A.A.C R18-9-A211(B)	A.A.C. R18-9-A211(B)(1)	Part or all of existing facility becomes a new facility	No	No new facilities are proposed
	A.A.C. R18-9-A211(B)(2)	Physical change in a permitted facility or change in its method of operation	No	No physical change is proposed to the permitted facility, the existing facility will be used as originally planned and permitted
	A.A.C. R18-9-A211(B)(3)	The facility can no longer demonstrate that its discharge will be compliant	No	Discharge will comply with the Aquifer Protection Permit (APP) No. P-101704
	A.A.C. R18-9-A211(B)(4)	The permittee requests less stringent monitoring that reduces the frequency or number of pollutants monitored	No	There is no requested reduction in monitoring frequency or number of pollutants monitored
	A.A.C. R18-9-A211(B)(5)	It is necessary to change the location of a point of compliance	No	There is no requested change in the location of points of compliance
	A.A.C. R18-9-A211(B)(6)	It is necessary to update Best Available Demonstrated Control Technology for a facility that was not constructed within 5 years of permit issuance	No	The subject facility was constructed as permitted
	A.A.C. R18-9-A211(B)(7)	The permittee requests less stringent discharge limitation	No	The requested discharge limitation is the same as originally permitted for the subject facility
	A.A.C. R18-9-A211(B)(8)	It is necessary to make an additional or substantial change in closure requirements to provide for post-closure monitoring and maintenance	No	There is no proposed change to the facility closure requirements which are already covered under APP No. P-101704
	A.A.C. R18-9-A211(B)(9)	Material and substantial changes to a permitted facility including change of disposal method	No	No change is proposed to the permitted facility or disposal method

**Table 2. Minor Amendment Permit Application Criteria**

Amendment Type	A.A.C. Reference	Description of Criterion	Applies to the Proposed Amendment	Notes
Minor Amendment	A.A.C. R18-9-A211(C)(1)	Correct a typographical error	No	The purpose of the requested amendment is not to correct typographical errors
	A.A.C. R18-9-A211(C)(2)	Change nontechnical administrative information	No	The purpose of the requested amendment is not to correct nontechnical administrative information
	A.A.C. R18-9-A211(C)(3)	Correct minor technical errors	No	The purpose of the requested amendment is not to correct minor technical errors
	A.A.C. R18-9-A211(C)(4)	Increase the frequency of monitoring or reporting, or to revise a laboratory method	No	The purpose of the requested amendment is not to change monitoring, reporting, or laboratory method requirements
	A.A.C. R18-9-A211(C)(5)	Make a discharge limitation more stringent	No	The purpose of the requested amendment is not to make discharge limitations more stringent
	A.A.C. R18-9-A211(C)(6)	Make a change in recordkeeping or retention requirement	No	No change is requested to recordkeeping or retention requirements
	A.A.C. R18-9-A211(C)(7)	Insert calculated alert level (AL), aquifer quality limits (AQL) or other permit limits based on monitoring subsequent to permit issuance if a requirement to establish the ALs or AQLs and the method of the calculation of the levels was established in the original permit	No	The permit does not include a requirement to establish alert levels subsequent to permit issuance

This requested amendment is for the purpose of calculating an AL in accordance with A.A.C. R18-9-A211(D)(2)(h). This requested amendment does not include a change in operation or monitoring of the facility, and consequently is not a Significant Amendment. Because the amendment does not make minor language changes, examples of which are provided in A.A.C. R18-9-A211(C), it is not a Minor Amendment.

Examples of actions that may constitute an Other amendment of an individual permit are provided in A.A.C. R18-9-A211(D)(2)(a-l). One of the examples provided in A.A.C. R18-9-A211(D)(2)(h) is:

*A calculation of an alert level, AQL, or other permit limit based on monitoring subsequent to permit issuance.*

Florence Copper herein requests an Other amendment of APP No. P-106360 for the purpose of submitting a calculated AL based on monitoring conducted subsequent to permit issuance in accordance with A.A.C. R18-9-A211(D)(2)(h).

## 1.2 GENERAL INFORMATION

The Florence Copper Project currently operates a production test facility (PTF) at the Florence Copper site for the purpose of demonstrating the feasibility of in-situ copper recovery. The PTF is currently in operation on the property in accordance with terms of APP No. P-106360. Applicant, owner, location and facility information are provided on the accompanying application form.

## 1.3 LANDOWNER INFORMATION (ITEM 11)

The Florence Copper Project site includes an area of approximately 1,342 acres that consists of two contiguous parcels of land. The land parcels consist of 1,182 acres held in fee simple ownership and 160 acres on Arizona State Trust Lands under Arizona State Mineral Lease 11-26500. Ownership information for the fee simple land and the Arizona State Land parcel are provided below.

### **Florence Copper Inc.**

Attn: Mr. Richard Tremblay  
1575 West Hunt Highway  
Florence, Arizona 85132  
(520) 374-3984

### **Arizona State Land Department**

Mineral Lease #11-26500  
Attn: Ms. Lisa Atkins  
1616 West Adams Street  
Phoenix, Arizona 85007  
(602) 542-4631

A copy of the lease agreement for the portion of the property on Arizona State Land is included as Exhibit 1-1.

## 1.4 OTHER STATE AND FEDERAL ENVIRONMENTAL PERMITS (ITEM 14)

1. APP No. P-101704, LTF No. 53498 issued 29 September 2017.
2. Underground Injection Control Permit No. R9UIC-AZ3-FY11-1 issued 20 December 2016.

## 1.5 FACILITY DESCRIPTION (ITEM 20)

The Florence Copper Project currently operates a PTF at the Florence Copper site for the purpose of demonstrating the feasibility of in-situ copper recovery. The PTF is currently in operation on the property in accordance with terms of APP No. P-106360. The PTF began operation in December 2018, and is planning to continue operating until December 2020, unless otherwise authorized by the amendment of APP No. P-101704. No changes to facility configuration, operation, discharging facilities, activities that discharge, sources of waste, or location of discharge are proposed in conjunction with the requested permit amendment.



## **1.6 PROCESS FLOW AND DISCHARGE (ITEM 21)**

The planned maximum volume of solution to be discharged to the water impoundment is 432,000 gallons per day or the equivalent of 300 gallons per minute (gpm). The maximum volume is listed on the application form and represents a discharge of the full PTF wellfield volume for a period of 24 hours in response to a hypothetical upset condition. No change to the process flow discharge is proposed in conjunction with the requested permit amendment.

## **1.7 DISCHARGING FACILITIES (ITEM 22)**

The currently authorized discharging facilities are listed on the accompanying permit application form. No change to discharging facilities operation, location, or discharge are proposed in conjunction with the requested permit amendment.

## **1.8 CHARACTERIZATION OF DISCHARGE (ITEM 25)**

The physical and chemical characteristics of discharge are described in the geochemical modeling report generated in 2015 in support of the APP application for the PTF facilities. No change to the characteristics of discharge is proposed in conjunction with the requested permit amendment.

## **1.9 DESIGN DOCUMENTS (ITEM 26)**

Not applicable. No change to the facility design is proposed in conjunction with the requested permit amendment.

## **1.10 BEST AVAILABLE DEMONSTRATED CONTROL TECHNOLOGY DESCRIPTION (ITEM 27)**

Not applicable. No new construction or modification of discharging facilities is proposed in conjunction with this amendment.

## **1.11 HYDROGEOLOGIC STUDY (ITEM 28)**

Not applicable. The purpose of the requested amendment is to revise the bulk EC ALs for the PTF wellfield. No hydrogeologic study is required to calculate the proposed bulk EC AL values.

## **1.12 DEMONSTRATION OF COMPLIANCE WITH AQUIFER WATER QUALITY STANDARD AT POINTS OF COMPLIANCE (ITEM 29)**

Not applicable. No changes are proposed to the existing points of compliance for the existing discharging facilities.

## **1.13 MONITORING PROPOSAL (ITEM 30)**

A detailed monitoring proposal describing the proposed revised bulk EC AI values is included in Appendix 2. No other changes are proposed to the existing monitoring program.

#### **1.14 CONTINGENCY PLAN (ITEM 31)**

Not applicable. No changes are proposed to the current contingency plan in conjunction with the requested permit amendment.

#### **1.15 CLOSURE AND POST-CLOSURE PLAN (ITEM 32)**

Not applicable. No changes are proposed to the closure and post-closure plan in conjunction with the requested permit amendment. Closure and post-closure costs for the water impoundment have been submitted to the Arizona Department of Environmental Quality within the past 5 years and remain current.

**EXHIBIT 1-1**

**Arizona State Land Mineral Lease**

# **MINERAL LEASE**

**11-26500**

Florence Copper Inc.  
1575 W. Hunt Highway  
Florence, AZ USA 85132

N2S2 Section 28, T4S, R9E  
Pinal County

## **Term**

December 13, 2013 – December 12, 2033

**STATE LAND DEPARTMENT**  
**STATE OF ARIZONA**



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# STATE OF ARIZONA

## MINERAL LEASE

Lease No. 11-26500

This mineral lease ("Lease") is entered into by and between the State of Arizona ("the State" or "Lessor"), Arizona State Land Department ("Department"), through the State Land Commissioner ("Commissioner"), and Florence Copper Inc. ("Lessee"), pursuant to A.R.S. § 27-254. In consideration of the payment of rent and royalties and of performance by the parties of each of the provisions set forth herein, the parties agree as follows:

### Article 1 LEASED LAND

- 1.1 **Lease Provisions.** Lessor hereby leases to Lessee, and Lessee hereby leases from Lessor, for the term, at the rent and royalty rate and in accordance with the provisions of this Lease, the State Land described below and in Appendix A ("Legal Description"), and as depicted in Appendix B ("Location Map") attached hereto and herein referred to as "the Leased Land".

Township 4S, Range 9E, Section 28, N2S2, Pinal County, 160.00 Acres

- 1.2 **Lease Condition.** Lessee takes the Leased Land "as is" and Lessor makes no expressed or implied warranties as to the physical condition of the Leased Land.

### Article 2 TERM

- 2.1 **Lease Term.** The term of this Lease:

Commences on the	<u>13<sup>th</sup></u>	day of	<u>December 2013</u>
And expires on the	<u>12<sup>th</sup></u>	day of	<u>December 2033</u>

unless canceled earlier or terminated as provided herein or as provided by law. Notwithstanding provisions of this Lease relating to termination or cancellation, the provisions on environmental or other indemnification, restoration, reclamation and insurance requirements survive the termination or cancellation of this Lease and remain enforceable

- 2.2 **Lease Termination.** Upon the sale, exchange, redemption, reconveyance, relinquishment or taking, whether by eminent domain or institutional use, lease of all or any portion of the Leased Land shall terminate on the date of such taking as to the property so taken.



### Article 3

#### RENT

- 3.1 **Rental Requirement.** Lessee shall pay rent to Lessor as follows for the use and occupancy of the Leased Land during the term of this Lease without offset or deduction and without notice or demand, as established on an annual basis.
- 3.2 **Annual Rent and Adjustments.** The annual rent is established by Lessor based on an August 1, 2014 appraisal of the Leased Land. Rent for this Lease shall be: \$60,500.00 per year. The rent will be billed in advance by the Department and is due on or before the anniversary date of the Lease. The Leased Land shall be reappraised and the annual rent reestablished after the Production Test Facility is completed and before the commercial phase of the operation is started.

### Article 4

#### COMMODITIES and UNITS OF PRODUCTION

- 4.1 **Mineral Commodity.** Copper
- 4.2 **Production Units.** Tons (short)

### Article 5

#### ROYALTY

- 5.1 **Royalty Rate.** Lessee shall pay the Lessor a royalty fee equal to a percentage of the gross value for all 'Minerals' (as defined in A.R.S. §27-231) 'Produced and Sold' (as that term is used in A.R.S. §27-234) from the Leased Land subject to such adjustments as may be permitted by the terms of this Lease.

- 5.1.1 **Sliding Scale Factor:** The Upper and Lower Limits (as defined in sections 5.1.2 and 5.1.3) utilized to determine the range of copper values upon which the Sliding Scale Factor ("SSF") is established, shall be re-evaluated and fixed on each January 1 over the Term of the Lease. The SSF shall range between two and eight percent. The SSF shall be calculated according to the following equation:

$$\text{SSF} = 6\% / (\text{Upper Limit} - \text{Lower Limit})$$

where: 6% represents the difference between the highest possible Royalty Rate (8%) and the lowest possible Royalty Rate (2%).

- 5.1.2 **Upper Limit:** The Upper Limit is defined as the copper price at which the maximum percentage royalty of 8% would be assessed.

As of December 13, 2013, the Upper Limit shall be \$3.98 per pound of copper. After January 1, 2015, the Upper Limit shall be reestablished annually on each January 1 such that it equals the numeric average of the monthly copper price, defined in section 5.2 as the Copper Index Price ("CIP"), calculated for the prior sixty (60) months plus one standard deviation for that same sixty (60) month period.



- 5.1.3 Lower Limit:** The Lower Limit is defined as the Modified Break-Even Copper Price, which is that copper price where the mining project associated with the Leased Land (i.e. the Florence Copper Project) has a net present value ("NPV") of zero.

As of December 13, 2013, the Lower Limit shall be \$2.81 per pound of copper. The Lower Limit shall be reestablished annually after January 1, 2015 by the Arizona State Land Department. The Lower Limit shall be the weighted average of the total production cost based on the future projections of mine revenue and operating cost (life of mine) as reported by Lessee to Lessor and to the Arizona State Department of Revenue ("DOR") annually pursuant to DOR Property Tax Form 82061-A.

- 5.1.4 Royalty Rate:** The Royalty Rate, for the period from January 1, 2014 to December 31, 2014 shall be two percent whenever the monthly average CIP is \$2.81 per pound or less (Lower Limit), and shall be eight percent whenever the monthly average CIP is \$3.98 per pound or more (Upper Limit). The Royalty Rate shall be calculated for any CIP that occurs within the range between \$2.81 per pound and \$3.98 per pound as follows:

$$\text{Royalty Rate} = [(CIP - \text{Lower Limit}) \times \text{SSF}] + \text{Minimum Royalty Rate}$$

where: CIP = monthly Copper Index Price  
Lower Limit = copper price fixed each January 1  
SSF = Sliding Scale Factor  
Minimum Royalty Rate = 2% (according to A.R.S. § 27.234.C)

- 5.2 Market Value:** The CIP shall be the average monthly "US Transaction" price as reported by *Platts Metals Week Price Notification Monthly Report*<sup>1</sup>

In the event that the above price ceases to be published, or for any reason becomes inappropriate for the purpose of this lease, a replacement CIP shall be selected by the Commissioner using a nationally recognized pricing index for major mineral commodities.

- 5.3 Gross Value:** The gross value for each calendar month shall be the sum, expressed in United States dollars, of all minerals produced and sold during the previous calendar month. The gross value for copper produced and sold during a calendar month shall be calculated as follows:

$$\text{Gross Value} = CIP \times \text{Pounds of Copper Produced and Sold}$$

where: CIP = copper index price  
Pounds of Copper Produced and Sold = pounds of copper produced and sold for the previous calendar month

The gross value for other minerals produced and sold during the calendar month shall be calculated in a manner similar to the gross value for copper produced and sold, valued in accordance with A.R.S. §27-234.

- 5.4 Monthly Royalty:** Each calendar month, Lessee shall pay the Lessor the Royalty (the 'Monthly Royalty') calculated based on minerals produced and sold from the Leased Land during the prior calendar month. The amount of the Monthly Royalty shall be calculated as follows:

$$\text{Monthly Royalty} = \text{Gross Value} \times \text{Royalty Rate}$$

where: Gross Value = calculated as defined in Section 5.3  
Royalty Rate = percentage as defined in Section 5.1

<sup>1</sup> Copyright © 2009 The McGraw-Hill Companies, Inc.



- 5.5 **Other Minerals:** In the event that other minerals or mineral products are produced and sold from the Leased Land, they shall be valued in accordance with A.R.S. §27-234 and similarly included in the computation of gross value. Should the mineral or mineral product not have a published price, the gross value shall be based on an appraisal that estimates the fair market price of the mineral (A.R.S. §27-234.B). This shall not apply to by-products from the waste water treatment plant.
- 5.6 **Production Reports:** Monthly production reports, including documentation when required, shall be submitted to the Lessor for each month, including reports for negative production, after the first month of production. Reports are due on or before the 15th of each month following the month of production.
- 5.7 **Minimum Annual Royalty:** Lessee shall pay to Lessor a minimum royalty of \$1,000.00 at the signing of the Lease, and a minimum royalty of \$3,200.00 each year thereafter on or before the anniversary of the Commencement Date of the Lease. The minimum annual royalty shall be a credit for Lessee, fully recoupable against production royalties (the Monthly Royalty in Article 5.4) due to Lessor for material used or removed; however, the entire portion of minimum annual royalty unused or not recouped upon the termination or expiration of the Lease shall be the sole property of Lessor. Lessee shall pay the minimum annual royalty each year regardless of use or removal of materials. The minimum annual royalty shall be a continuing credit during the term of the Lease.
- 5.8 **Royalty Payments:** Royalty payments shall be due within thirty (30) days after billing by the Department.
- 5.9 **Appraisal Costs:** If, during the term of this Lease, the Lessor determines that a new appraisal is appropriate pursuant to A.R.S. §27-234.C, the Lessor shall arrange for such appraisal and the Lessee shall pay to Lessor within 30 days of the Lessor's request the cost of the appraisal. Such reappraisal shall be required after the completion of the Production Test Facility and before the commercial phase of the operation is started to reestablish the royalty rate.
- 5.10 **Failure to Pay:** If Lessee fails to pay royalty or appraisal costs described in this Article, on or before the date the payment is due, the amount due accrues interest at the rate and in the manner determined pursuant to A.R.S. §42-1123. If it is determined that failure to pay royalty is not due to reasonable cause, a penalty of five percent (5%) of the amount found to be remaining due shall be added to the royalty for each month or fraction of a month elapsing between the due date and the date on which it is paid. The total penalty shall not exceed one-third (1/3) of the royalty remaining due. The penalty so added to the royalty is due and payable within (10) days of notice and demand from the Commissioner. If any royalty, appraisal assessment, interest, or penalty is not paid by the Lessee when due, the unpaid amounts constitute a lien from the date the amounts become due on all property and rights to property belonging to the Lessee that are located on the Leased Land.

## **Article 6**

### **USE OF LEASED LAND**

- 6.1 **Purpose.** The Leased Land is leased to Lessee for the purposes of mineral extraction and for uses related thereto and no other use.
- This Lease confers the right to extract, process and ship minerals, mineral compounds, and mineral aggregates from the Leased Lands within planes drawn vertically downward through the exterior boundary lines thereof.
- 6.2 **Consistent With Mine Operating Plan.** Any use of the Leased Land must be performed in a manner consistent with the approved Mine Operating Plan as required under the provisions of Article 21.



**Article 7**  
**RECORDS AND INSPECTION**

- 7.1 **Annual Records.** Lessee shall provide the following records on an annual basis to Lessor on or before each anniversary of the effective date of this Lease:
- 7.1.1 Annual Operations Status Report which includes: an itemized statement of mineral production, total tons of materials mined and processed, total acres disturbed, and total acres reclaimed, and an annual groundwater monitoring report.
  - 7.1.2 Relevant Arizona State Department of Revenue form(s) (82061-A for copper, 82061-B for non-copper, 82061-C for small-scale mines).
  - 7.1.3 Any additional records pertinent to appraisal, compliance with this Lease and mineral production deemed necessary by the Commissioner.

**Article 8**  
**TAXES; ADDITIONAL AMOUNTS**

- 8.1 **Assessments Paid By Lessee.** Lessee shall pay all assessments and charges for utilities and communication services, and assessments imposed pursuant to any construction on the Leased Land, all permit and authorization fees, all taxes, duties, charges and assessments of every kind or nature imposed by any public, governmental or political subdivision authority pursuant to any currently or subsequently enacted law, ordinance, regulation or order, which during the term of this Lease, becomes due or are imposed upon, charged against, measured by or become a lien on (a) the Leased Land, (b) any improvements or personal property of Lessee located on the Leased Land, and (c) the interest of Lessee to this Lease or in the proceeds received by Lessee from any assignment or sublease of the Leased Land.
- 8.2 **Assessment Deadline.** Lessee shall pay or cause to be paid all amounts required to be paid under Paragraph 8.1 before any interest, penalty, fine or cost accrues for nonpayment.

**Article 9**  
**WAIVER**

- 9.1 **Waiver Definition.** Acceptance of rent and/or royalty payments by Lessor shall not constitute a waiver by Lessor of any violation by Lessee of the provisions of this Lease.
- 9.2 **Future Waiver.** No waiver of a breach of any provision of this Lease shall be construed as a waiver of any succeeding breach of the same or any other provision.

**Article 10**  
**IMPROVEMENTS**

- 10.1 **Non-Permanent Improvements.** This Lease confers the right to Lessee to place non-permanent improvements consistent with the approved Mine Operating Plan as required under the provisions of Article 21. Upon the expiration, termination or abandonment of this Lease, Lessee shall be obligated to



remove improvements consistent with Approved Reclamation Plan as required under the provisions of Article 22. To the extent that non-permanent improvements may remain following closure and reclamation as required under Article 22, Lessee shall have the right to remove the improvements if all monies owing to the State under the terms of this Lease have been paid.

## **Article 11**

### **LESSEE'S COOPERATION; INGRESS AND EGRESS**

- 11.1 **Reasonable Department Ingress.** Representatives of the Department may enter, and Lessee shall maintain access to the Leased Land at reasonable times to inspect the workings, improvements and other facilities used to extract or sever minerals from Leased Land. Representatives of the Department may enter at reasonable times to obtain factual data or access to records pertinent to mineral production required to be kept under the terms of this Lease and otherwise ascertain compliance with the law and the terms of this Lease.
- 11.2 **Reasonable Notice.** Inspections, investigations, and audits conducted under Article 11.1 shall be on reasonable notice to Lessee unless reasonable grounds exist to believe that notice would frustrate the enforcement of the law or the terms of this Lease.
- 11.3 **Lessee Appearance at Commissioner's Office.** The Commissioner may require Lessee to appear at reasonable times and on reasonable notice at the Commissioner's office and produce such records and information as are specified in the notice to determine compliance with the terms of this Lease.
- 11.4 **Lessee Cooperation.** Lessee shall cooperate with Lessor in Lessor's inspection, appraisal and management of the Leased Land and permit reasonable access by Lessor's employees to isolated State Land across Lessee's private land during the term of this Lease.
- 11.5 **Lessee Interference.** Lessee shall not unreasonably interfere with the authorized activities of Lessor's employees, agents, other lessees, and permittees or right-of-entry holders on the Leased Land.
- 11.6 **Established Rights-of-Way.** This Lease is made subject to all legally established rights-of-way heretofore granted or that may hereafter be granted over and across the Leased Land.
- 11.7 **Ingress and Egress to Other State Lands.** This Lease confers the right of ingress and egress to other State land, whether or not leased for purposes other than mining.

## **Article 12**

### **LOSS OR WASTE**

- 12.1 **Lessee Waste.** Lessee shall not cause, nor grant permission to another to cause, any waste (destruction, misuse, alteration, or neglect) in or upon the Leased Land. This provision does not apply to activities authorized by this Lease that are subject to the reclamation and environmental requirements of this Lease.



**Article 13**  
**NATIVE PLANTS AND CULTURAL RESOURCES**

- 13.1 **Native Plants.** Lessee shall not move, use, destroy, cut or remove or permit to move any used, destroyed, or cut timber, cactus, native plants, standing trees or products of the land except that which is necessary for the use of the Leased Land, and then only with the prior written approval of Lessor. Lessee must submit a plant survey prior to the removal of any native plants. If the removal or destruction of plants protected under the Arizona Native Plant Law (A.R.S. § 3-901 et seq., or any successor statutes) is necessary to the use of the Leased Land, Lessee shall also obtain written approval of the Arizona Department of Agriculture. In the event Lessee removes the native plants, Lessee must pay a vegetation fee to Lessor and this fee is not a reimbursable improvement. Lessee is responsible for treatment of all regulated and restricted noxious weeds listed by the Arizona Department of Agriculture.
- 13.2 **Invasive Species.** Measures to limit the introduction of invasive species and any additional non-native species will be accomplished using Best Management Practices. This will include the use of certified weed-free straw or fiber roll logs for use in reclamation and/or sediment containment.
- 13.3 **Cultural Resources.** Prior to initiating any operation or activity requiring surface or ground disturbance, Lessee shall comply with all conditions and provisions of the most recently approved plans and agreements associated with the National Historic Preservation Act of 1996. If prehistoric or historic features, artifacts or properties, vertebrate paleontological sites, including fossilized footprints, inscriptions made by human agency or any other archaeological, paleontological or historical feature are encountered, Lessee shall immediately cease all work in the immediate vicinity of the encounter and notify and consult with the State Historic Preservation Office (SHPO), the Arizona State Museum (ASM) and the Department regarding avoidance, preservation, recovery and/or curation.

Lessee further agrees that:

- 13.3.1 Lessee shall ensure that all cultural resource investigations on the Leased Land are permitted pursuant to A.R.S. §41-841, et seq., and that the investigations and resulting reports satisfy the terms of the permit.
- 13.3.2 Lessee shall ensure that two copies of the report describing the results of the completed cultural resource survey of the Leased Land are submitted to Lessor for Lessor's use in consulting with SHPO pursuant to A.R.S. §41-861, et seq.
- 13.3.3 Lessee shall cause no surface disturbance within the boundaries of any known archaeological sites without Lessor approval.
- 13.3.4 If any previously unknown human remains, funerary objects, sacred ceremonial objects or objects of tribal patrimony, archaeological, paleontological or historical site or object that is at least 50 years old are encountered during surface disturbing activities, Lessee shall cease operations immediately and report the discovery to Lessor and to the Director of the ASM pursuant to A.R.S. §41-844.
- 13.3.5 At any and all times that ground disturbing activities are being performed on the Leased Land, Lessee shall have a qualified archaeologist on site to monitor the operations and insure compliance with the provisions of Article 13.3.



**Article 14**  
**PROTECT LAND, PRODUCTS AND IMPROVEMENTS**

- 14.1 **Reasonable Means.** Lessee is hereby authorized to use means which are reasonable and which do not result in a breach of the peace or in creating a concealed hazard, to protect the Leased Land and improvements against waste, damage and trespass. In the event of known trespass on the Leased Land resulting in damage thereto, Lessee shall make reasonable efforts to notify Lessor and appropriate law enforcement authorities.
- 14.2 **Fencing.** Lessee shall, at its expense, fence all shafts, prospect holes, adits, tunnels, process ponds and other dangerous mine workings for the protection of public health and safety and livestock.
- 14.3 **Compliance with Applicable Regulations.** Lessee shall comply with all requirements of any governmental agency having jurisdiction over Lessee's activities on the Leased Land.

**Article 15**  
**RESERVATIONS, RELINQUISHMENTS TO UNITED STATES**

- 15.1 **Rights-of-Ways and Easements.** Lessor reserves the right to grant rights-of-way, easements and sites over, across, under or upon the Leased Land for public highways, railroads, utility lines, pipelines, irrigation works, flood control, drainage works and other purposes.
- 15.2 **Relinquishing Lands for Federal Projects.** Lessor reserves the right to relinquish to the United States land needed for irrigation works in connection with a government reclamation project and to grant or dispose of rights-of-way and sites, for canals, reservoirs, dams, power or irrigation plants or works, railroads, tramway, transmission lines or any other purpose or use on or over the Leased Land.
- 15.3 **Compensation Waiver.** In the event of such relinquishment, grants or disposals, Lessee waives all right to any compensation whatsoever against Lessor except as may be allowed under the provisions of Article 16 and as limited therein.

**Article 16**  
**CONDEMNATION**

- 16.1 **Division of Condemnation Awards.** Lessor, any pertinent leasehold mortgagees and, if Lessee is not in default, Lessee, shall cooperate in prosecuting and collecting their respective claims for an award on account of a taking of all or any portion of the Leased Land and all damages or awards (with any interest thereon) to which Lessor, Lessee or any pertinent leasehold mortgagees may be entitled by reason of any taking of all or any portion of the Leased Land (herein referred to as "Condemnation Proceeds"). In the event of the taking or condemnation by any competent authority for any public or quasi-public use or purpose of all or any portion of the Leased Land at any time during the Lease Term, the rights of Lessor, Lessee, or any leasehold mortgagees, to share in the net proceeds of any award for land, buildings, improvements and damages upon any such taking, shall be apportioned as follows:
- (i) Lessee shall receive that portion attributed to the then fair market value of the buildings and improvements constructed thereon and Lessee shall receive the fair market value immediately prior to such taking of Lessee's leasehold interest in the Leased Land so taken;



(ii) Lessor shall receive the fair market value of its reversionary interest under this Lease (exclusive of any value attributable to improvements).

The entire amount of the award, settlement or payment attributable to the value of buildings and improvements shall belong to Lessee.

- 16.2 **Lease Termination.** If the whole or materially all of the Leased Land shall be taken or condemned by a competent authority, this Lease shall cease and terminate and all rental, additional rent and other charges hereunder shall be apportioned as of the date of vesting of title in such taking or condemnation proceedings. For the purposes of this Article, a taking or condemnation of materially all of the Leased Land, as distinguished from a taking or condemnation of the whole of the Leased Land, means a taking of such scope that: (a) the untaken portion of the Leased Land is not reasonably usable for Lessee's purposes or is insufficient to permit the reclamation of the then existing improvement thereon or is insufficient to permit the recovery of the cost of reclamation of the then existing improvements thereon, or (b) the remaining untaken portion of the Leased land and the improvements thereon are incapable of producing a proportionately fair and reasonable net annual income, taking into consideration the payment of all operating expenses thereof including but not limited to the net rental, additional rental and all other charges herein reserved and after the performance of all covenants, agreements and provisions herein provided to be performed by Lessee. The determination of what constitutes a fair and reasonable net annual income shall be governed by reference to the average net annual income produced by the Leased Land during the five-year period immediately preceding the taking (or, if the taking occurs during the first five years of the Lease Term, during the Lease Term to date). As used above, the term "operating expenses" does not include depreciation or income taxes. If there is any controversy as to whether materially all of the Leased Land has been taken, the controversy shall be resolved by arbitration.

If materially all of the Leased Land are taken or condemned, then Lessee, at its option, upon thirty (30) days prior notice to Lessor, given at any time within ninety (90) days after the vesting of title in the condemnor, may cancel and terminate this Lease as to the entire Leased Land. The rent and other charges hereunder shall be prorated as of this date of termination.

- 16.3 **No Termination of Lease.** In the event of a partial taking or condemnation, i.e. a taking or condemnation of less than materially all of the Leased Land, this Lease (except as hereinafter provided) shall nevertheless continue, but the rent for the Lease Year in which such condemnation occurs shall be prorated as of the date of such condemnation and that portion of the rent attributable to that portion of the Leased Land so taken shall be credited to Lessee's obligations next arising under this Lease and the rent shall be reduced proportionately to reflect the loss of the land taken.

- 16.4 **Temporary Taking of Lease.** If the whole or any part of the Leased Land or of Lessee's interest under this Lease be taken or condemned by any competent authority for its or their temporary use or occupancy for a period which is fewer than four (4) months, this Lease shall not terminate by reason thereof and Lessee shall continue to pay, in the manner and at the times herein specified, the full amounts of the rent and all additional rent and other charges payable by Lessee hereunder, and, except only to the extent that Lessee may be prevented from so doing pursuant to the terms of the order of the condemning authority, to perform and observe all of the other terms, covenants, conditions and obligations hereof upon the part of Lessee to be performed and observed, as though such taking or condemnation had not occurred. If the whole or any part of the Leased Land or Lessee's interest in this Lease be taken or condemned by a competent authority for its or their temporary use or occupancy for a period which is in excess of four (4) months, this Lease may be terminated at the option of Lessee upon notice given within thirty (30) days of the taking or condemnation. Notwithstanding anything to the contrary herein, in the event of any temporary taking or condemnation Lessee shall, if this Lease has not been terminated as provided in this Article, be entitled to receive the entire amount of any award made for such taking or condemnation, whether paid by way of damages, rent or otherwise, unless such period of temporary use or occupancy shall extend to or beyond the Expiration Date, in which case such award shall be apportioned between Lessor and Lessee as of such Expiration Date.



**Article 17**  
**USE OF WATER**

- 17.1 **Groundwater Rights.** Lessee shall be entitled to the use on the Leased Land of groundwater as defined in A.R.S. §45-101, or any successor statute, for purposes consistent with this Lease. Lessee shall obtain all required permits from the Arizona Department of Water Resources ("ADWR"). If Lessee shall develop any groundwater on the Leased Land, Lessee shall not acquire any rights with respect to the groundwater, except the right to use such water in accordance with applicable law, on the Leased Land during this Lease.
- 17.2 **Alternate Groundwater Source.** If Lessee uses, on the Leased Land, groundwater, or water from other sources, that use shall not (1) cause such water or any rights with respect to that water to be appurtenant to the Leased Land, or (2) affect in any way Lessee's rights with respect to the water, or unlawfully degrade groundwater quality.
- 17.3 **Well Abandonment.** Prior to the Lessee vacating the Leased Land, Lessee agrees to contact the Department to confirm whether the well(s) are required to be abandoned or capped. If requested by the Department, the Lessee may be required to conduct groundwater quality analysis. All fees associated with well capping, abandonment, and groundwater quality analysis shall be borne by the Lessee.
- 17.4 **Surface Water Rights.** The rights of Lessor and Lessee concerning the application for an establishment of any rights with respect to surface water as defined in A.R.S. §45-101, or any successor statute, shall be governed by State law.
- 17.5 **Validity of Surface Water Rights.** Nothing in the provisions of this Lease shall affect the validity of any rights established by or for Lessor or Lessee with respect to surface water, as defined in A.R.S. §45-101, prior to the commencement date of this Lease.
- 17.6 **Establishment of Water Rights.** The application for and establishment by Lessor or Lessee (as agent of the State of Arizona) of any surface or groundwater rights shall be in the name of the State of Arizona (Arizona State Land Department), and; such rights shall attach to and become appurtenant to the Leased Land in accordance with the provisions of A.R.S. Title 45, Chapters 1 and 2.
- 17.7 **Lessor Notification.** Lessee shall promptly notify Lessor in writing of any initial filings made by Lessee with any governmental agency or court concerning the establishment or adjudication of any claim to a water right relating to the Leased Land. Upon request of Lessor, Lessee shall furnish copies of any document filed with the agency or court.
- 17.8 **Annual Report.** The ADWR requires an annual report of groundwater pumped from non-exempt well(s) within both Active Management Areas and Irrigation Non-Expansion Areas. If applicable, Lessee shall submit to ADWR the Annual Water Withdrawal and Use Report and associated fees within the time period specified by ADWR. Lessee shall provide a copy of such report to Lessor.
- 17.9 **Water Use Not Beneficial to Lease.** If Lessee desires to move groundwater off the Leased Land, or use groundwater for purpose(s) different from those stated in this Lease, Lessee shall file an application with Lessor for a public auction water sale. Movement of groundwater from the Leased Land prior to a public auction is prohibited.
- 17.10 **Guarantee of Availability or Quality.** Lessor, by issuing this Lease, makes no guarantee with respect to groundwater availability or groundwater quality.
- 17.11 **Lessor's Access.** Lessee shall provide the Lessor's personnel access to well(s) on the Leased Land.



**Article 18**  
**DEFAULT AND CANCELLATION**

- 18.1 **Default Definition.** Violation by Lessee of any provision of this Lease shall be a default hereunder entitling Lessor to any and all remedies it may have under State law.
- 18.2 **Lease Cancellation.** Upon any such default, this Lease may be canceled pursuant to A.R.S. §37-289 or any successor statute.
- 18.3 **Cancellation for Conflict of Interest.** Pursuant to A.R.S. § 38-511, the State or any department or agency of the State may, within three years after its execution, cancel any lease, without penalty or further obligation, made by the State or any of its departments or agencies if any person significantly involved in initiating, negotiating, securing, drafting or creating the lease on behalf of the State or any of the departments or agencies of the State, is at any time while the lease is in effect, an employee or agent of any other party to the lease in any capacity or a consultant to any other party of the lease with respect to the subject matter of the lease. A cancellation made pursuant to this provision shall be effective when Lessee receives written notice of the cancellation unless the notice specifies a later time. (moved from 23.12)
- 18.4 **Lessee Lease Termination.** Lessee may terminate this Lease at any time during its term by giving the Commissioner thirty (30) days written notice of the termination, if Lessee is not delinquent in the payment of rent, royalty or appraisal fees to the date of termination, and if the Leased Land has been reclaimed to a condition satisfactory to the Commissioner.

**Article 19**  
**INDEMNIFICATION AND INSURANCE**

- 19.1 **Lessee Defense of Actions or Proceedings.** In case an action or proceeding is brought against Lessor by reason of any such occurrence, Lessee, upon Lessor's request and at Lessee's expense, will resist and defend such action or proceedings, or cause the same to be resisted and defended either by counsel designated by Lessee or, where such occurrence is covered by liability insurance, by counsel designated by the insurer.
- 19.2 **Indemnification of State of Arizona.** To the extent allowed by law, Lessee shall defend, indemnify and hold harmless the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees (hereinafter for Article 19 referred to as "State of Arizona") from and against any and all claims, actions, liabilities, damages, losses, or expenses (including court costs, attorneys' fees, and costs of claim processing, investigation and litigation) (hereinafter referred to as "Claims") for bodily injury or personal injury (including death), or loss or damage to tangible or intangible property caused, or alleged to be caused, in whole or in part, by the negligent or willful acts or omissions of Lessee or any of its owners, officers, directors, agents, employees or sublessees, arising out of or related to Lessee's occupancy and use of the Leased Land. It is the specific intention of the parties that the State of Arizona shall, in all instances, except for Claims arising solely from the negligent or willful acts or omissions of the State of Arizona, be indemnified by Lessee from and against any and all claims. It is agreed that Lessee will be responsible for primary loss investigation, defense and judgment costs where this indemnification is applicable. This indemnity shall not apply if the Lessee or sublessee(s) is/are an agency, board, commission or university of the State of Arizona.
- 19.3 **A. Minimum Scope and Limits of Insurance.** Lessee shall procure and maintain until such time as all obligations under the terms of this Lease are met, insurance against claims for injury to persons or



damage to property which may arise from or in connection with the Lease.

The insurance requirements herein are minimum requirements for this Lease and in no way limit the indemnity covenants contained in this Lease. The State of Arizona in no way warrants that the minimum limits contained herein is sufficient to protect the Lessee from liabilities that might arise out of the performance of this Lease. Lessee is free to purchase additional insurance.

Lessee shall provide coverage with limits of liability not less than those stated below.

**1. Commercial General Liability (CGL) – Occurrence Form**

Policy shall include bodily injury, property damage, personal and advertising injury, Explosion, Collapse, and Underground (XCU), and products and completed operations.

• General Aggregate	\$2,000,000
• Products – Completed Operations Aggregate	\$1,000,000
• Personal and Advertising Injury	\$1,000,000
• Damage to Rented Premises	\$ 50,000
• Each Occurrence	\$1,000,000

a. The policy shall be endorsed, as required by this Lease, to include the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees as additional insureds with respect to liability arising out of the use and/or occupancy of the Leased land.

b. Policy shall contain a waiver of subrogation endorsement as required by this Lease in favor of the State of Arizona, and its departments, agencies, boards, commissions, universities, and its officers, officials, agents, and employees for losses arising out of the use and/or occupancy of the Leased Land.

**2. Excess/Umbrella Liability** in the minimum amount of \$5,000,000 to follow form the primary CGL policy.

**3. Business Automobile Liability.** To cover all owned, hired and/or non-owned of Lessee in the minimum amount of \$1,000,000.

**NOTE LIMIT:**

**If hazardous materials are to be transported** **\$5,000,000**

\*If the Lease includes hazardous materials transportation, the automobile liability policy shall include the following endorsements:

- CA 99-48 Pollution Liability – broadened coverage for covered autos
- MCS-90 (Motor Carrier Act) – endorsements

a. The policy shall provide **Automobile Pollution Liability** specific to the transportation of hazardous materials.

The policy shall be endorsed as required by this Lease, to include the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees as additional insureds with respect to liability arising out of the activities performed by or on behalf of the Lessee, involving automobiles owned, leased, hired or borrowed by the Lessee.

Policy shall contain a waiver of subrogation endorsement as required by this Lease in favor of the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees for losses arising from work performed by or on behalf of the Lessee.



#### 4. Worker's Compensation and Employers' Liability

- Workers' Compensation Statutory
  - Employers' Liability
    - Each Accident \$1,000,000
    - Disease – Each Employee \$1,000,000
    - Disease – Policy Limit \$1,000,000
- a. Policy shall contain a waiver of subrogation endorsement as required by this Lease in favor of the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees for losses arising from work performed by or on behalf of the Lessee.
- b. This requirement shall not apply to: Separately, EACH contractor or subcontractor exempt under A.R.S. § 23-901, AND when such contractor or subcontractor executes the appropriate waiver (Sole Proprietor/Independent Contractor) form.

#### 5. Contractor's (Lessee's) Pollution Liability

For losses caused by pollution conditions that arise from the operations of the Lessee as described in this lease, Lessee shall also require its contractor(s) to provide coverage for activities performed by or on behalf of the Lessee.

Each Occurrence	\$10,000,000
General Aggregate	\$10,000,000

- a. Coverage must be *identified as specific to the operations* as described in the Lease.
- b. Must include coverage pollution losses arising out of completed operations.
- c. The policy should be written on an "occurrence" basis with no sunset clause.
- d. Pollution coverage must apply to all phases of the work described in the Lease.
- e. The policy shall include coverage for bodily injury, sickness, disease, mental anguish or shock sustained by any person, including death and medical monitoring costs.
- f. The policy shall include coverage for property damage including physical damage to or destruction of tangible property and the resulting loss of use thereof, clean-up costs, and the loss of use of tangible property that has not been physically damaged or destroyed including diminution in value.
- g. The policy shall include coverage for Environmental damage including physical damage to soil, surface water or ground water, or plant or animal life, caused by Pollution Conditions and giving rise to Cleanup Costs.
- h. The policy shall include defense including costs, charges and expenses incurred in the investigation, adjustment or defense of claims for such compensatory damages.
- i. The policy shall include coverage for asbestos and lead, mold, and no exclusions.
- j. The policy shall include Non-Owned Disposal Site coverage.
- k. The policy shall be endorsed as required by this Lease to include the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees as additional insureds with respect to liability arising out of the activities performed by or on behalf of the Lessee.
- l. Policy shall contain a waiver of subrogation endorsement as required by this Lease in favor of the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees for losses arising from work performed by or on behalf of the Lessee.



- m. Should any of the work involve treatment, storage or disposal of hazardous wastes, the Lessee shall furnish an insurance certificate from the disposal facility establishing that the facility operator maintains current Pollution Legal Liability Insurance in the amount of not less than \$10,000,000 per occurrence / \$10,000,000 annual aggregate and will cover sudden and gradual pollution losses arising from the facility, associated with work performed under this Lease.

Minimum Scope of Coverage: For pollution losses arising from the Lessee's operation, coverage shall apply to sudden and gradual pollution conditions including the discharge, dispersal, release or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids or gases, waste materials or other irritants, contaminants or pollutants into or upon land, the atmosphere or any watercourse or body of water, which results in Bodily Injury or Property Damage. The policy should include the following coverages:

- i. Bodily injury, sickness, disease, mental anguish or shock sustained by any person, including death and medical monitoring costs
- ii. Property damage, including physical injury to or destruction of tangible property including the resulting loss of use thereof, clean-up costs, and the loss of use of tangible property that has not been physically injured or destroyed and diminution in value.

#### 6. Pollution Legal Liability

Lessee shall provide coverage and cause its contractor(s) to provide coverage as required for the acceptance, storage or disposal of any hazardous materials, with limits of at least:

Each Occurrence	\$10,000,000
Annual Aggregate	\$10,000,000

- a. Coverage must be *identified as specific to the operations and specific site(s)* described in the Lease.
- b. Pollution coverage must apply to all locations utilized for the acceptance, storage or disposal of any hazardous materials
- c. The policy shall include bodily injury, sickness, disease, mental anguish or shock sustained by any person, including death and medical monitoring costs.
- d. The policy shall include property damage including physical damage to or destruction of tangible property including the resulting loss of use thereof, clean-up costs, and the loss of use of tangible property that has not been physically damaged or destroyed.
- e. For losses that arise from the disposal facility that is accepting hazardous material, coverage shall apply to sudden and non-sudden pollution conditions including the discharge, dispersal, release or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids or gases, waste materials or other irritants, contaminants or pollutants into or upon land, the atmosphere or any watercourse or body of water, which results in cleanup costs, bodily injury or property damage.
- f. The policy shall include defense, including costs, charges and expenses incurred in the investigation, adjustment or defense of claims for such compensatory damages.
- g. The policy shall be endorsed as required by this Lease, to include the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees as additional insureds with respect to liability arising out of the activities performed by or on behalf of the Lessee.
- h. Policy shall contain a waiver of subrogation endorsement as required by this Lease in



favor of the State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees for losses arising from work performed by or on behalf of the Lessee.

**B. Additional Insurance Requirements.** The policies shall include, or be endorsed to include, these provisions:

1. The State of Arizona, and its departments, agencies, boards, commissions, universities, officers, officials, agents, and employees wherever additional insured status is required. Such additional insured shall be covered to the full limits of liability purchased by Lessee, even if those limits of liability are in excess of those required by this Lease
2. Lessee's insurance coverage shall be primary insurance with respect to all other available sources.
3. Coverage provided by Lessee shall not be limited to the liability assumed under the indemnification provisions of this Lease.
4. If Lessee's Contractors and/or Subcontractors do not have or cannot obtain such coverage, Lessee's certificate(s) may include all its Contractors/Subcontractors as insureds under its policies or Lessee shall be responsible for ensuring and/or verifying that all Contractors/Subcontractors have collectable insurance as evidenced by the certificates of insurance and endorsements for each Contractor/Subcontractor. All coverages for Contractors/Subcontractors shall be subject to the applicable insurance requirements identified above. The Department reserves the right to require, at any time, proof from the Lessee that its Contractors/Subcontractors have the required coverage.

**C. Notice of Cancellation:** Each insurance policy required by the insurance provisions of this Lease shall not be suspended, voided, cancelled, reduced in coverage or in limits except after thirty (30) days' prior written notice has been given to the State of Arizona. Such notice shall be sent directly to:

Minerals Section  
Arizona State Land Department  
1616 West Adams Street  
Phoenix, Arizona 85007

and shall be sent by certified mail, return receipt requested.

**D. Acceptability of Insurers.** Lessee's insurance shall be placed with companies licensed in the State of Arizona or hold an approved non-admitted status on the Arizona Department of Insurance List of Qualified Unauthorized Insurers. Insurers shall have an "A.M. Best" rating of not less than A- VII. The State of Arizona in no way warrants that the above-required minimum insurer rating is sufficient to protect the Contractor from potential insurer insolvency.

**E. Verification of Coverage.** Lessee shall furnish Lessor with certificates of insurance (ACORD form or equivalent approved by the State of Arizona) as required by this Lease. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements are to be received and approved by Lessor before the Lease Term commences. Each insurance policy required by this Lease must be in effect at or prior to the commencement of this Lease and must remain in effect for the duration of this Lease. Failure to maintain the insurance policies as required by this Lease or to provide timely evidence of renewal will be considered a material breach of this Lease. All certificates required by this Lease shall be sent directly to the Department. The Department's Lease number (11-26500) and location description of the Leased Land are to be noted on the certificate of insurance. Lessor reserves the right to require complete, certified copies of all insurance policies and endorsements required by this Lease at any time.



- F. **Modifications:** Any modification or variation from the insurance requirements in this Lease shall be made by the Lessor in consultation with the Arizona Department of Administration, Risk Management Division. Such action will not require a formal Lease amendment, but may be made by administrative action.
- G. **Approval:** The Lessor reserves the right to review, or make modifications to the insurance limits, required coverages or endorsements throughout the life of this Lease as deemed necessary. In such event, the Lessor shall provide the Lessee with written notice of such and the Lessee shall comply within thirty (30) days of receipt thereof.

## Article 20

### ENVIRONMENTAL MATTERS

- 20.1 **Definition of Regulated Substances and Environmental Laws.** For purposes of this Lease, the term "Environmental Laws" shall include but not be limited to any relevant federal, state or local environmental laws, and the regulations, rules and ordinances relating to environmental matters, and publications promulgated pursuant to the federal, state and local laws and any rules or regulations relating to environmental matters applicable to Lessee's operations on the Leased Land. For the purpose of this Lease, the term "Regulated Substances" shall include but not be limited to substances defined as "regulated substance," "solid waste," "hazardous waste," "hazardous materials," "hazardous substances," "toxic materials," "toxic substances," "inert materials," "pollutants," "toxic pollutants," "herbicides," "fungicides," "rodenticides," "insecticides," "contaminates," "pesticides," "asbestos," "environmental nuisance," "criminal littering," or "petroleum products" as defined in Environmental Laws.
- 20.2 **Compliance with Environmental Laws.** Lessee shall strictly comply with all applicable Environmental Laws, including, without limitation, water quality, air quality, and handling, transportation, storage, treatment, or disposal of any Regulated Substance on, under, or from the Leased Land. Without limiting the foregoing, compliance includes that Lessee shall: (i) comply with all reporting obligations imposed under Environmental Laws; (ii) obtain and maintain all permits required by Environmental Laws and provide copies to Lessor within ten business days of receipt of the permits; (iii) provide copies of all documentation relating to the Leased Land as required by Environmental Laws to Lessor within ten business days of Lessee's submittal and/or receipt of the documentation; (iv) during the Term of this Lease, provide copies of all information it receives or obtains regarding any and all environmental matters relating to the Leased Land, including but not limited to environmental audits relating to the Leased Land regardless of the reason for which the information was obtained or whether or not the information was required by Environmental Laws; and (v) prevent treatment, storage, disposal, handling or use of any Regulated Substances within the Leased Land without prior written authorization from Lessor. The permitted use of Regulated Substances in the performance of lease activities shall not exempt future obligation of Lessee to remediate any environmental condition that may result from such use. Lessor retains full right to require future remediation or restoration.
- 20.3 **Designated Compliance Officer.** Lessee at all times shall employ or designate an existing employee, consultant or representative (the "Designated Compliance Officer") who is responsible for knowing all Environmental Laws affecting Lessee and Lessee's business and monitoring Lessee's continued compliance with applicable Environmental Laws. Upon request by Lessor, Lessee shall make the Designated Compliance Officer available to discuss Lessee's compliance, answer any questions, and provide such reports and confirming information as Lessor may reasonably request.
- 20.4 **Environmental Audit.** At any time, Lessor may request Lessee to provide an environmental audit of the Leased Land performed by an Arizona registered professional engineer or an Arizona registered geologist. Lessee shall pay the entire cost of the audit.



- 20.5 **Environmental Assessment.** At any time during the Term of this Lease, with reasonable cause, Lessor may require Lessee to obtain a Phase I environmental assessment of the Leased Land, performed in accordance with most current ASTM standard by an Arizona registered professional engineer or an Arizona registered geologist. If, based upon the Phase I environmental assessment or its own independent investigation, Lessor identifies any possible violation of Environmental Laws or the terms of this Lease, Lessor may require Lessee to conduct additional environmental assessments as Lessor deems appropriate for the purpose of ensuring that the Leased Land are in compliance with Environmental Laws. The Phase I assessment, or any other assessment required by Lessor, shall be obtained for the benefit of both Lessee and Lessor. A copy of the Phase I report shall be provided both to Lessee and Lessor. Lessor, in its sole discretion, shall have the right to require Lessee to perform additional assessments of any damage to the Leased Land arising out of any violations of Environmental Laws. If Lessee fails to obtain any assessment required by Lessor, Lessee shall pay the entire costs of any and all assessments required by Lessor, notwithstanding the expiration or termination of this Lease.
- 20.6 **Indemnity for Environmental Damage.** Lessee shall defend, indemnify and hold Lessor harmless from and against any and all liability, obligations, losses, damages, penalties, claims, environmental response and cleanup costs and fines, and actions, suits, costs, taxes, charges, expenses and disbursements, including legal fees and expenses of whatever kind or nature (collectively, "claims" or "damages") imposed on, incurred by, or reserved against Lessor in any way relating to or arising out of any non-compliance by Lessee, Lessee's successors or sublessees, with any Environmental Laws, the existence or presence from and after the Commencement Date of this Lease of any Regulated Substance, on, under, or from the Leased Land, and any claims or damages in any way relating to or arising out of the removal, treatment, storage, disposition, mitigation, cleanup or remedying of any Regulated Substance on, under, or from the Leased Land by Lessee, its agents, contractors, or subcontractors.
- 20.7 **Scope of Indemnity.** This indemnity shall include, without limitation, claims or damages arising out of any and all violations of Environmental Laws regardless of any real or alleged fault, negligence, willful misconduct, gross negligence, breach of warranty, or strict liability on the part of any of the indemnities. This indemnity shall survive the expiration or termination of this Lease and/or transfer of all or any portion of the Leased Land and shall be governed by the laws of the State.
- 20.8 **Lessee's Participation in the Defense.** In the event any action or claim is brought or asserted against Lessor which is or may be covered by this indemnity, Lessee shall fully cooperate and pay for the defense of the action or claim including but not limited to the following: (i) the conduct of any required cleanup, removal or remedial actions and/or negotiations, (ii) the conduct of any proceedings, hearings, and/or litigation, and (iii) the negotiation and finalization of any agreement or settlement. Lessor shall retain the right to make all final decisions concerning the defense.
- 20.9 **Restoration.** Prior to the termination of this Lease and in addition to those obligations set forth in this Lease, Lessee shall restore the Leased Land by removing or remediating any and all Regulated Substances to the satisfaction of the Lessor. In addition, the restoration shall include, but not be limited to, removal of all waste and debris deposited by Lessee. If the Leased Land or any portions thereof are damaged or destroyed from the existence or presence of any Regulated Substance or if the Leased Land or any portions thereof are damaged or destroyed in any way relating to or arising out of the removal, treatment, storage, disposition, mitigation, cleanup or remedying of any Regulated Substance, Lessee shall arrange, at its expense, for the repair, removal, remediation, restoration, and reconstruction to the Leased Land, and groundwater in accordance with the approved mine reclamation and closure plans under Article 22. In any event, any damage, destruction, or restoration by Lessee shall not relieve Lessee from its obligations and liabilities under this Lease. The insurance provisions within this Lease shall remain in place until such time as the required restoration is complete and approved by the regulatory authority and the Lessor.



## Article 21

### MINE OPERATING PLAN

- 21.1 **Approved Mine Operating Plan.** All development or mining operations, or any use of the Leased land shall be performed in a manner consistent with an approved Mine Operating Plan, submitted as part of Lessee's Mineral Development Report entitled "Mineral Extraction Operating Plan – Reclamation and Closure Plan" as revised March 13, 2014. The Approved Mine Operating Plan shall comply with Lessee's final, approved Temporary Individual Aquifer Protection Permit (No. P-106360), which Lessee must obtain from the Arizona Department of Environmental Quality ("ADEQ"). The Mine Operating Plan is to conform to the Department's plan requirements, and be submitted to and approved by the Department prior to the commencement of any operation upon the Leased Land.
- 21.2 **Lessee Performance.** Upon approval, Lessee shall perform all operations in a manner and time consistent with the Mine Operating Plan.
- 21.3 **Mine Operating Plan Amendments.** Amendments to the Mine Operating Plan must be filed with and approved by the Department whenever the operation deviates from previously approved plans, including mine expansion. Any amendments to the Mine Operating Plan will require changes to the Approved Reclamation Plan in Article 22.1 and may also require changes to the amount of the Reclamation Bond in Article 22.3. Upon completion of the Production Test Facility, and before Lessee starts the commercial phase of the mining operation, the Mine Operating Plan and Approved Reclamation Plan will require major amending or complete revision.
- 21.4 **Compliance of Agents and Subcontractors.** Lessee shall comply, and assure that its agents, sublessees and subcontractors comply with the applicable transportation laws and ordinances pertaining to operation of trucks on roadways and Lessee shall consult with the Arizona Department of Transportation to address safety issues.
- 21.5 **Overburden Piles.** Overburden piles resultant from mining shall be placed and maintained (with riprap if necessary) to prevent any eroded sediment from entering washes.
- 21.6 **Drainage Report.** Lessee shall prepare and submit to Lessor a drainage report which identifies appropriate steps required to control runoff, minimize erosion, maintain water quality and otherwise prevent any adverse impacts on perennial surface flow. Failure to comply with such requirements shall constitute a default hereunder. Such report is subject to Lessor's approval and Lessor may seek input from ADEQ. At no time will Lessee permit a permanent body of water, not identified in the ADEQ permit, to be maintained on the site; however it is acknowledged that heavy rain falls and/or wet seasons may result in storm water temporarily collecting on the Leased Land.

## Article 22

### RECLAMATION AND CLOSURE PLANS AND CONDITIONS

- 22.1 **Detailed Reclamation and Closure Plan.** Lessee shall not commence mining activities unless or until Lessor shall have approved in writing the Reclamation and Closure Plan ("Approved Reclamation Plan"), including any amendments thereto, submitted as part of Lessee's Mineral Development Report entitled "Mineral Extraction Operating Plan – Reclamation and Closure Plan" as revised March 13, 2014. The Approved Reclamation Plan shall comply with Lessee's final, approved Temporary Individual Aquifer Protection Permit (No. P-106360), which Lessee must obtain from ADEQ including the Closure and Post-Closure Plans. Reclamation shall include contouring and landscaping the land to match in a natural manner the surrounding native landscape and landforms and shall be performed concurrent with ongoing mining activities to the extent practicable. Reclamation shall include processes and procedures as identified in the Temporary Individual Aquifer Protection Permit, and as approved by the Lessor.



Reclamation shall also include contouring and landscaping all other portions of the State Trust land parcel disturbed by Lessee not specifically identified in or made part of the Approved Reclamation Plan.

- 22.2 **Final Reclamation.** Lessee shall complete final reclamation within one hundred twenty (120) days following the end of the Lease Term. Such final reclamation shall be in accordance with the Approved Reclamation Plan.
- 22.3 **Reclamation Bond.** Upon Lessor's approval of the Approved Reclamation Plan and prior to the commencement of mining activities, Lessee shall provide Lessor with a bond or other form of security to insure the full performance of Lessee's reclamation and closure activities. The form of such bond or security shall be subject to Lessor's written approval. The amount of the bond or security shall be \$63,000.00. This amount is intended to cover reclamation of the approximately 14 acres of surface to be used by the Production Test Facility at a cost of \$4,500.00 per acre. Upon completion of the Production Test Facility, and before Lessee starts the commercial phase of the mining operation, the amount of the bond or security will be reassessed. At Lessee's expense, Lessor may obtain the services of a consultant to help determine the amount and sufficiency of the new bond or security requirement based on the then-prevailing reclamation costs and the progress of Lessee's concurrent reclamation efforts. Lessor shall have the sole discretion to determine the acceptable amount of bond or security if conditions change during the term of this Lease. When Lessor notifies Lessee in writing of the acceptable amount of the bond or security, Lessee shall increase or decrease the bond or security within thirty (30) days thereafter.

## Article 23 MISCELLANEOUS

- 23.1 **Lessee Rights.** This Lease grants Lessee only those rights expressly granted herein.
- 23.2 **Lease Governance.** This Lease shall be governed by, construed, and enforced according to State laws.
- 23.3 **Applicable Rules, Regulations, and Laws.** This Lease is subject to all current and subsequently enacted rules, regulations and laws applicable to State land as though fully set forth herein.
- 23.4 **Fee Interest.** No provisions of this Lease shall create any right or interest in Lessee to a fee interest in the Leased Land
- 23.5 **Non-Availability of Funds.** Every obligation of the State under this Lease is conditioned upon the availability of funds appropriated or allocated for the payment of such obligation. If funds are not allocated and available for the continuance of this Lease, this Lease may be terminated by the State at the end of the period where funds are available. No liability shall accrue to the State if this provision is exercised, and the State shall not be obligated or liable for any future payments or any damages as a result of termination under this paragraph.
- 23.6 **Non-discrimination.** Lessee shall comply with Executive Order 99-4, which mandates that all persons, regardless of race, color, religion, sex, age, national origin or political affiliation, shall have equal access to employment opportunities, and all other applicable State and federal employment laws, rules, and regulations, including the Americans with Disabilities Act. Lessee shall take affirmative action to ensure that applicants for employment and employees are not discriminated against due to race, creed, color, religion, sex, national origin or disability.
- 23.7 **Lessor Liability.** Lessor shall be forever wholly absolved from any liability for damages which might result to Lessee in the event this Lease is found to be void, canceled, forfeited or terminated prior to the Expiration Date or in the event this Lease is not renewed.



- 23.8 **Failure to Receive Title.** If, for any reason, it is determined that Lessor has failed to receive title to any of the Leased Land, this Lease is void insofar as it related to the Leased Land to which Lessor has failed to receive title. In such event Lessee waives all right to any compensation as against Lessor, except prorated reimbursement for prepaid rent.
- 23.9 **Reasonable Attorney's Fees.** In any action arising out of this Lease, the prevailing party shall recover reasonable attorneys' fees incurred therein in addition to the amount of any judgment, costs and other expenses as determined by the court. In the case of Lessor, reasonable attorneys' fees shall be calculated at the reasonable market value for such services when rendered by private counsel notwithstanding that it is represented by the Arizona Attorney General's Office or by other salaried counsel.
- 23.10 **Arbitration.** In the event of a dispute between the parties to this Lease, it is agreed to use arbitration to resolve the dispute but only to the extent required by A.R.S. §12-1518; and, in no event shall arbitration be employed to resolve a dispute which is otherwise subject to judicial review pursuant to A.R.S. §12-901, et seq., and administrative review by the Department pursuant to statute or Department Administrative Rule.
- 23.11 **Document Delivery Requirements.** Any notice to be given or other documents to be delivered by one party to the other shall be in writing and served by personal delivery or by depositing same in the United States mail, postage prepaid. Correspondence to the Department shall be addressed as follows:
- Minerals Section  
Arizona State Land Department  
1616 West Adams Street  
Phoenix, Arizona 85007
- Correspondence to Lessee shall be made to the address of record as indicated following Lessee's signature line(s) herein. Each party is obligated to promptly notify the other party in writing of any change in the foregoing addresses. Notice shall be deemed adequate if sent to the last known address of record.
- 23.12 **Effective Lease Terms.** Any attempt to assign, sublease, convey, and transfer or otherwise dispose of any estate or interest in this Lease, for a time period that exceeds the Lease Term, shall not be effective and shall be cause for cancellation.
- 23.13 **Lessor Supervision.** The Department shall not be responsible for the supervision of any activities conducted under the terms of this Lease.
- 23.14 **Current Lease Agreement.** This Lease, together with all attached Appendices, embodies the whole agreement between the parties. This document supersedes all previous communications, representations and agreements, oral or written, between the parties. There are no other agreements or terms, oral or written.
- 23.15 **Lease Execution.** This document is submitted for examination. This is not an option or offer to lease or grant a permit. This document shall have no binding effect on the parties unless and until executed by Lessor (after execution by Lessee), and a fully executed copy is delivered to Lessee.



**Article 24**  
**ASSIGNMENT**

- 24.1 **Lease Assignment.** Lessee, if not in default in the payment of any monies owed the State in regard to this Lease and having kept and performed all the conditions of this Lease, may, with the written consent of Lessor, assign this Lease.
- 24.2 **Filing Lease Assignments.** Copies of assignments pertaining to the Leased Land shall be filed with Lessor.

**Article 25**  
**RENEWAL**

- 25.1 **Lease Renewal.** Upon application to the Department not less than thirty (30) nor more than one hundred and twenty (120) days prior to the Expiration Date, Lessee, if a bona fide resident of the State or legally authorized to transact business in the State, shall have a preferred right to renewal for a term as provided by law, bearing even date with the Expiration Date subject to requirements of A.R.S. § 37-284 and A.R.S. § 27-235 if applicable. The preferred right of renewal shall not extend to Lessee if there has not been substantial compliance with the terms of this Lease or if the Leased Land was not used as prescribed in this Lease, unless for good cause the failure to perform was given written authorization by the Department. If the Department determines the continued leasing of the land to Lessee is not in the best interest of the State, this Lease will not be renewed.

**Article 26**  
**HOLDOVER LESSEE**

- 26.1 **Surrender of Possession.** Within one hundred twenty (120) days after expiration or termination of this Lease, Lessee agrees to surrender to Lessor peaceful and uninterrupted possession of the Leased Land. Holdover tenancy by Lessee is prohibited and shall be deemed a trespass for which Lessor may seek all appropriate legal remedies; except that Lessee if in good standing and who has filed a timely application for renewal may continue to occupy and use the Leased Land with Department approval, pursuant to the terms of this Lease, pending action on the renewal application by Lessor.

Appendix A  
LEGAL DESCRIPTION

STATE OF ARIZONA LAND DEPARTMENT  
1616 W. ADAMS  
PHOENIX, AZ 85007

KE-LEASE#: 11-26500-00

APPTYPE: RENEWAL

AMENDMENT#: 0

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<u>LAND #</u>	<u>LEGAL DESCRIPTION</u>	<u>ACREAGE</u>
T4S, R9E, S28	N2S2	160.00





**Arizona State  
Land Department**  
1815 Vincennes Street Phoenix, AZ 85007

IN WITNESS WHEREOF, the parties hereto have signed this Lease effective the day and year set forth in Article 2.1

ARIZONA STATE LAND DEPARTMENT  
State Land Commissioner

By:

*Janissa P. Hickman*



FLORENCE COPPER INC.

Lessee

*Rita Nappier, Executive Vice President*  
Authorized Representative Title

Signature

*December 15, 2014*  
Date

Address

*1575 W. Hart Hwy*

City

*Florence, Ariz.*  
State

Zip

*85132*

## **APPENDIX 2**

### **(Item 30) Monitoring Proposal**



**PROPOSED BULK ELECTRICAL CONDUCTIVITY ALERT LEVELS  
PRODUCTION TEST FACILITY  
FLORENCE COPPER PROJECT**

by Haley & Aldrich, Inc.  
Phoenix, Arizona

for Florence Copper Inc.  
Florence, Arizona



Exp. 9/30/21

File No. 129687-011  
January 2020

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# 1. Introduction

Florence Copper Inc. (Florence Copper) has constructed the Production Test Facility (PTF) as a demonstration of In-Situ Copper Recovery (ISCR) at the Florence Copper Project (Site) in Florence, Arizona. The Temporary Aquifer Protection Permit No. P-106360 (APP) and the Underground Injection Control (UIC) Permit No. R9UIC-AZ3-FY11-1 for the PTF mandate the establishment of a bulk electrical conductivity (EC) monitoring program for the interface between the lower basin fill unit (LBFU) and the bedrock oxide unit (Oxide). The purpose of this monitoring proposal is to establish new alert levels (AL) for the bulk EC monitoring required at the PTF wellfield. No other monitoring changes are proposed in this monitoring proposal.

Prior to operation of the PTF, Florence Copper collected ambient bulk EC data at the PTF wellfield for the purpose of establishing baseline conditions and the calculation of bulk EC ALs. The ambient data were collected between 24 May and 3 August 2018 on a total of 25 days, 5 more than the minimum 20 days required by the APP. Daily data collection was conducted 5 times per week from 24 May through 21 June 2018, after which 5 additional daily measurements were collected from 30 July through 3 August 2018. The additional week of data collection was added to further evaluate the effects of operating PTF equipment in monsoon storms. The baseline bulk EC data showed sensitivity to precipitation events, but otherwise had relatively low variability (generally less than 1 ohm-meter [ $\Omega$  m]). The variability of the baseline dataset, sensitivity to environmental changes, and method for calculation of the ALs were described in the AL proposal dated August 2018. The 2018 AL proposal noted that rainfall was observed to affect the bulk EC measurements because it added soil moisture at the surface which would lower temperatures in the surficial infrastructure used to collect the data. Temperature fluctuations change the resistivity of the cables used to transmit the signals to and from the wells from the resistivity instrument as well as the cables at the surface used as reference electrodes.

The initial ambient bulk EC data were collected over a relatively short period of time in the summer of 2018, and consequently were not expected to fully characterize potential variability arising from seasonal environmental changes in ambient temperatures and in soil moisture. The August 2018 AL proposal noted that these types of seasonal changes have the potential to affect the surficial components of the bulk EC monitoring system, the grounding network, and the reference electrodes used to process the raw bulk EC data.

Bulk EC data collected on 21 November 2019, reflected a downward shift in resistivity values of a sufficient magnitude to result in exceedance of the AL at five sensor pairs located on three monitoring horizons. The observed downward shift affected all sensor pairs on all monitoring horizons at the PTF wellfield. The exceedances were subsequently confirmed by bulk EC measurements made on 26 November and 3, 4, and 5 December 2019. As described further below, the downward shift in bulk EC values followed successive precipitation events which resulted in environmental changes that affected all bulk EC measurements taken at the PTF wellfield.

In accordance with Section 2.6.2.7 of the APP, within 30 days of the confirmed exceedances, Florence Copper completed a report describing the cause, impact, and mitigation of the bulk EC exceedances. The report (included as Attachment 1) concluded that the downward shift in bulk EC values was the result of environmental changes resulting from the preceding precipitation events, similar to the demonstrated sensitivity observed during the initial ambient monitoring.

As a result of the observed sensitivity to changes in surficial environmental conditions, Florence Copper herein proposes to calculate new ALs for use in continued bulk EC monitoring. This monitoring proposal summarizes the bulk EC data collected since the beginning of operational monitoring and presents revised bulk EC ALs, calculated using the same procedure used to establish the initial ALs, which incorporates the broader monitoring record and observed temporal variability.



## 2. Bulk EC AL Calculation Methodology Defined in the APP

Section 2.5.9 of the APP describes methodology for calculating the bulk EC ALs. The methodology described in the APP was used to establish the initial bulk EC ALs, and is defined as the following:

1. *Outlier test to identify observations that deviate markedly from other observations in the dataset.*
2. *An analysis of variance (ANOVA) of means.*
3. *A regression analysis to identify which observed variations are significant and to identify interfering correlations which could be affecting the observations (e.g., temperature, time of day, electrical storm activity, etc.).*

The same statistical methodology applied to the initial ambient dataset was applied to the subsequent monitoring data to calculate the ALs proposed herein.

### 2.1 BULK ELECTRICAL CONDUCTIVITY SENSORS

The bulk EC compliance monitoring system includes three bulk EC sensors, installed on each of the seven observation wells (identified as O-01 through O-07) at the edge of the PTF wellfield, resulting in a total of 21 sensors for compliance monitoring. One additional sensor is installed at each observation well, at a depth of 20 feet below the lowest compliance sensor for use in operational monitoring. The total of 28 sensors are configured to create four horizontal monitoring horizons with a vertical separation of 20 feet between each horizon. The monitoring horizons are numbered 1 through 4, with horizon 1 being the highest in elevation and horizon 4 being the lowest. Horizon 4 is located in the middle of the 40-foot thick exclusion zone and is used for operational monitoring. This allows Florence Copper to adjust operations prior to an excursion reaching the compliance bulk EC sensors 20 feet above at the contact between bedrock and the LBFU. Bulk EC monitoring horizon 3 is at the bedrock LBFU contact, monitoring horizon 2 is 20 feet above the contact within the LBFU, and monitoring horizon 1 is 40 feet above the contact, also within the LBFU. The sensors are numbered as follows, from shallowest to deepest:

- BC-01 (BC1-02 in wells O-03 and O-07): these are the shallowest sensors and are located within the LBFU, approximately 40 feet above the LBFU/Oxide lithologic contact in each well.
- BC-02 (BC1-04 in wells O-03 and O-07): these sensors are located approximately 20 feet above the LBFU/Oxide lithologic contact in each well.
- BC-03 (BC2-02 in wells O-03 and O-07): these sensors are located at the LBFU/Oxide lithologic contact in each well.
- BC-04 (BC2-04 in wells O-03 and O-07): these sensors are located within the exclusion zone of the Oxide, approximately 20 feet below the LBFU/Oxide lithologic contact.

A summary of the sensor depths and elevations is provided in Table 1. Figure 1 shows the locations of the PTF observation wells at which the bulk EC sensors are installed.

### 3. Bulk Electrical Conductivity Data Collection and Preparation

#### 3.1 DATA COLLECTION

The operational monitoring period began prior to injection of ISCR solutions on 21 September 2018 and extends through the present. Injection at the PTF wellfield began on 21 December 2018. The data used to calculate the ALs proposed herein include data collected between 21 September 2018 and 3 January 2020, incorporating 3 months of operational bulk EC monitoring prior to the commencement of injection. The operational monitoring data provide an opportunity to characterize seasonal environmental changes affecting bulk EC values observed at the PTF. Potential greater temporal variability may be observed in the future during wetter or drier periods than those occurring during the data collection period; however, these data provide the best opportunity to evaluate temporal variability based on existing observations. Because the ISCR fluid is highly conductive, and the bulk EC data is collected in units of resistivity (the inverse of conductivity), an excursion of fluid would result in significantly decreased resistivity values.

At each monitoring event, conductivity measurements between each sensor pair, in both the forward and reverse directions, results in 378 unique measurements. Data collection is conducted using a SuperSting™ R8 Resistivity Instrument. The HydroGeophysics (HGI) field personnel collected the data in accordance with their quality assurance/quality control (QA/QC) procedures, which are included with the form used to document data collection and evaluation. A copy of the HGI Bulk Conductivity Data QA/QC Procedure and Documentation Form (V.2) is included in Attachment 2.

#### 3.2 DATA POST-PROCESSING

The raw forward and reverse direction bulk EC data were measured in units of resistance ( $R = V/I$ , where  $R$  is resistance in ohms [ $\Omega$ ],  $V$  is voltage, and  $I$  is electrical current). The resistance of a material varies with the length and cross-sectional area of the material the current travels through (Aizebeokhai, 2010; Pierce et al., 2012). Thus, the resistance measured between two sensors will increase with distance. Electrical resistivity, in contrast, is a physical material property that depends on the composition of the material that current passes through. It is commonly reported as apparent resistivity ( $\rho_a$ , in  $\Omega\cdot m$ ), which represents the weighted average of the true resistivity values near a measurement. Resistance can be converted to apparent resistivity by scaling with a geometric factor that accounts for the positions of the current introduction and potential measurement sensors, as follows (Pierce et al., 2012):

$$\rho_a = K \cdot R$$

- Where  $\rho_a$  is apparent resistivity and  $K$  is the geometric factor

For the pole-pole array used in the bulk EC tests at the PTF, the following expression gives K (Bevc and Morrison, 1991; Loke, 2018):

$$K = 2\pi \cdot a$$

- Where a is the distance between the active transmitting and receiving sensors

The measured raw forward and reverse direction background bulk EC values were first averaged for each sensor pair measurement, and then converted to apparent resistivity using the above equation. The average apparent resistivity values were used in further statistical evaluation. The tabulated bulk EC dataset, with all measurements reported in apparent resistivity, is included in Attachment 3.

### 3.3 DATA GROUPING

The bulk EC dataset has been divided into groups representing lithologic horizons. For each horizon, only sensor pairs for which both sensors had the same relative lithologic location are evaluated together. For example, the shallowest horizon, horizon 1, includes the sensor pairs highest in the wells (all sensors numbered BC-01, and BC1-02 in wells O-03 and O-07); that is, the sensors located approximately 40 feet above the LBFU/Oxide contact. In total, this grouping creates four horizons, each of which contains 21 sensor pairs.

The APP establishes bulk EC AL values for monitoring horizons 1 through 3. Horizon 4 is located 20 feet below horizon 3 in the middle of the 40-foot thick exclusion zone and does not have an AL. The three upper horizons, horizons 1 through 3, are within the LBFU or at the LBFU/Oxide contact. Therefore, they are monitored to demonstrate compliance with the APP conditions. Monitoring horizon 4 is used for operational monitoring to allow Florence Copper to identify changing conditions prior to a potential vertical excursion reaching the LBFU.

## 4. Procedures for Determining Alert Levels (ALs)

Statistical evaluation of the average apparent resistivity was performed in two steps:

1. Exploratory data analysis was conducted to understand the data distribution and variability of the bulk EC data over the monitoring period.
2. Nonparametric tolerance limits at a 95 percent confidence level were determined to be an appropriate statistical method for calculating ALs for the baseline bulk EC data based on the exploratory data analysis findings. The ALs were calculated for horizons 1, 2, and 3.

The nonparametric tolerance limits for horizons 1, 2, and 3, and the minimum detect values are listed in Table 2. The proposed bulk EC ALs are listed in Table 3.

### 4.1 EXPLORATORY DATA ANALYSIS

The bulk conductivity dataset was examined by using various graphical and statistical test procedures to characterize the variability in the measurements. Descriptive statistics were calculated for the data from each sensor pair, including the number of observations, data range, mean, median (50<sup>th</sup> percentile), 95<sup>th</sup> percentile, variance, standard deviation, and coefficient of variation.

Exploratory data analysis was conducted to assess distribution and temporal trends. Normality of the dataset was determined using Shapiro-Wilk tests at a significance level of 5 percent, as well as normal probability plots. Data distribution and outlier presence was evaluated graphically using box plots, by grouping all apparent resistivity measurements from all dates for each sensor pair. ANOVA tests were used to assess the differences in mean between various data groups, including by day and sensor location.

Variations in the data over time were evaluated using time series plots for each sensor pair. For each series, two-tailed Mann-Kendall trend tests at a significance level of 5 percent were performed to identify the presence of a stable, increasing, or decreasing trend. These variations were examined alongside changing site conditions, including electrical activity in the wellfield, rainfall, and temperature. The exploratory analysis plots are presented in Attachment 4.

#### 4.1.1 Observed Spatial Patterns

In general, resistivity varies depending on lithology, moisture content, dissolved electrolyte content, and fluid temperature (McNeill, 1980). Resistivity tends to decrease with increased porosity, water content, and salinity (Loke, 2018).

The apparent resistivity values for the Florence PTF wellfield range from approximately 9 to 17  $\Omega$ -m (Attachment 4), which is consistent with established values for weathered igneous rocks (Palacky, 1987).

#### 4.1.2 Observed Temporal Patterns

Measured bulk EC values vary throughout the monitoring period in response to changing environmental conditions. Comparison of bulk EC data collected during the monitoring period to precipitation data show correlation between precipitation events and observed declines in bulk EC values. Figures 2



through 8 are time series plots of the average measured bulk EC values at each of the four monitoring horizons at each of the seven observation wells throughout the operational monitoring period beginning on 21 September 2018 and extending through 3 January 2020. The bulk EC data are plotted together with precipitation data from a weather station (National Oceanic & Atmospheric Administration Station ID US1AZPN0075) located approximately 3.3 miles northeast of the PTF wellfield.

Figures 2 through 8 show that decline in bulk EC values occurred on all four monitoring horizons following significant rain events throughout 2019, and that successive smaller rain events have a cumulative residual effect on bulk EC values. During dry periods between rain events, as residual soil moisture evaporates and soil temperatures rise, bulk EC values appear to stabilize or trend upwards.

Figures 2 through 8 also show the following characteristics:

1. A downward shift of bulk EC values has occurred at a similar magnitude on every monitoring horizon (horizons 1 through 4) following significant precipitation events and successive smaller precipitation events. Review of the underlying data (Attachment 3) show that a similar magnitude downward shift occurs on every sensor pair in the monitoring system on every monitoring horizon. This shift indicates that changing conditions affected the entire monitoring system equally, and that the change is not related to upward migration of injected fluid, but rather is associated with a change in the baseline conditions in the grounding network or reference electrodes used to process the individual bulk EC measurements.
2. The downward shift in bulk EC values detected on 21 November 2019 was preceded by two precipitation events (14 and 20 November 2019) that each produced greater than 1 inch of precipitation. Similar declines in bulk EC values were preceded by precipitation events on 25 September 2019, cumulative precipitation events between 31 January through 14 February 2019, and cumulative precipitation events between 5 and 19 October 2018. Similar to the 21 November precipitation event, each of the earlier precipitation events preceded a system-wide decline in bulk EC values.
3. The observed changes in bulk EC values are not spatially localized within the PTF wellfield, indicating that there is not a localized pathway for vertical migration of solution.
4. The observed change in bulk EC values did not progress from the lowest level sensors on monitoring horizon 4, upward to horizons 3, 2, and 1 as would be expected if a vertical excursion of injected fluid had occurred. Rather, the change occurred at a similar magnitude, at the same time, at all sensor pairs on all monitoring horizons. The significance of this is that roughly equal magnitude change occurred on horizons 1 and 4 at the same time, indicating that the cause of the change is not upward movement of injected fluid.
5. The resistivity values measured at monitoring horizon 4 remain higher than those measured in horizons 3, 2, and 1. This indicates that injected solution has not migrated upward through horizon 4 to reach horizons 3, 2, and 1. Had injected solution migrated vertically upward, it is anticipated that the lowest monitoring horizon, horizon 4, would have a lower resistivity than the overlying horizons instead of the higher values measured at horizon 4.
6. Additional rain events occurred following the initial exceedance detection on 21 November and during the period when confirmation monitoring was conducted resulting in effects similar to those resulting from earlier storm events.

It is important to note that precipitation falling on the ground surface at the PTF wellfield is not infiltrating to the bulk EC sensors located in the well bores to cause a decrease in bulk EC values. Rather, precipitation falling on the surface is affecting the equipment, grounding network, and reference electrode system located at ground surface which are used to collect the bulk EC data for processing the raw data.

#### 4.1.3 Hydraulic Control During Changes in Bulk EC Measurements

Florence Copper maintained hydraulic control throughout the period of time that the bulk EC exceedances occurred. Successful hydraulic control is indicated by two criteria established in the APP, listed in Table 4.1-8 of the permit as “Recovered Volume to Injection Volume” and “Inward Hydraulic Gradient.” These two criteria provide objective physical indicators that hydraulic control has been maintained.

Table 4.1-8 of the APP requires that Florence Copper maintain a fluid recovery rate that is greater than the injection rate. The purpose of this criterion is to ensure that a cone of depression is formed at the PTF wellfield, inducing inward flow of groundwater from the surrounding formation. This criterion is fundamental to the maintenance of hydraulic control during injection operations. Section 2.7.4.4.1 of the APP requires that, on a quarterly basis, Florence Copper submit in a graphical format the daily injected and recovered volumes of fluid and the percent recovery of fluid as a demonstration that hydraulic conductivity has been maintained daily. Florence Copper has maintained a daily fluid recovery rate that is greater than the injection rate throughout the fourth quarter of 2019, including the days prior to, during, and following the occurrence of bulk EC exceedances. Tables 4, 5, and 6 list the daily injection and recovery volumes for the months of October, November, and December 2019, respectively. Figure 9 shows the daily injection and recovery volumes, and the percent recovery during the months of October, November and December 2019. The data provided in Tables 5 and 6 and plotted on Figure 9 show that Florence Copper maintained a greater recovery rate than injection rate throughout the period of time prior to, during, and following the occurrence of the observed bulk EC exceedances.

Table 4.1-8 of the APP requires that Florence Copper maintain a 1-foot water level differential between recovery and observation wells located at the corners of the PTF wellfield. The purpose of this criterion is to demonstrate inward flow of groundwater from the surrounding formation. Section 2.7.4.4.2 of the APP requires that, on a quarterly basis, Florence Copper submit the daily water level measurements for observation wells and recovery wells located at the corners of the wellfield as an additional demonstration that hydraulic control has been maintained daily. Tables 7, 8, and 9 list the daily water levels at each of the subject observation and recovery wells. Figures 10a through 10h show the daily water level differential between the observation and recovery wells. The water level data provided in tables 7, 8, and 9 and the plots provided in Figures 10a through 10h show that the required minimum 1-foot gradient was maintained throughout the time prior to, during, and following the occurrence of the observed bulk EC exceedances.

The data plotted on Figures 9 and 10a through 10h demonstrate that Florence Copper maintained the injection and recovery volume balance and the inward hydraulic gradient required to maintain hydraulic control at the PTF wellfield during the period of time prior to, during, and following the observed bulk EC exceedances. This fact indicates that observed exceedances are not the result of a loss of hydraulic control.

#### **4.1.4 Potential Seasonal Variability**

The August 2018 AL proposal noted the possibility that seasonal variability of environmental conditions affecting the bulk EC measurements may result in fluctuations that exceed the calculated ALs proposed in that document. The proposal also noted that it may be necessary to reevaluate the ALs after data has been collected during times with cooler ambient air and soil temperatures. The dataset used to calculate the bulk EC ALs proposed in this document includes a broader range of seasonal variability of environmental conditions. As contemplated in the original bulk EC AL proposal, these bulk EC observations indicate that apparent resistivity measurements change throughout the wellfield in response to environmental conditions such as meteorological events. If greater changes are observed with seasonal or weather shifts, Florence Copper will conduct additional data collection to identify the source of the changes and will request an amendment to the APP to establish new ALs if necessary.

#### **4.1.5 Potential Sensor Drift**

The sensors are stainless steel probes that have been encased in the cement seal of each observation well bore. Over time, the sensors are expected to chemically interact with the cement and formation chemistry. This interaction may result in oxidation of the sensors, and cause changes in the measured bulk EC values, potentially leading to drift in the baseline values.

Importantly, the signature of an excursion is expected to be notably different from any sensor drift that might occur, even if the sensor drift causes the measured bulk EC values to approach the ALs. Because the ISCR fluid is very conductive, an excursion of fluid from the injection zone would abruptly change the measured bulk EC value in a very short time frame, in contrast to the gradual changes that would be expected from sensor drift.

If sensor drift is observed, depending on its magnitude, bulk EC values may approach the ALs on one or more horizons across the wellfield. If this type of change is observed over time, Florence Copper will conduct additional data collection to identify the source of the changes and will request an amendment to the APP to establish new ALs if necessary.

#### **4.1.6 Potential Equipment Drift**

As equipment is added, removed, or replaced in the wellfield or a well has to be replaced or worked over, the changed conditions could potentially cause drift in the baseline bulk EC values. Changes caused by these events are expected to be less significant than would be caused by an excursion of the highly conductive ISCR fluid. Changes of this nature will be documented during bulk EC data collection events. If changes are observed that are a result of these types of changes, additional data collection will be conducted to confirm the condition, and Florence Copper will request an amendment to the APP to establish new ALs if necessary.

### **4.2 DETERMINATION OF ALERT LEVELS**

#### **4.2.1 Lithologic Horizons**

The reference dataset shows variability by lithologic horizon, with resistivity generally increasing from horizon 1 to 4 (Figures 2 through 8). Due to these lithology-based differences in bulk EC, the proposed ALs are calculated for the entire lithologic horizons (horizons 1 through 3). The electrode pair data



within discrete lithologic horizons was grouped together and evaluated to establish a general AL that applies to all sensor pairs located within a given lithologic horizon. The data from horizon 4, within the Oxide unit, will be collected and used as an indicator that would allow Florence Copper to modify operations if the data collected indicates that fluid has reached that level.

During each future monitoring event, the data from all electrode pairs will be collected and transmitted to the Arizona Department of Environmental Quality as part of the quarterly compliance report.

#### **4.2.2 Dataset Tolerance Limits**

Exploratory analysis showed that the horizon data was nonparametric. Therefore, a nonparametric tolerance limit approach was used to determine ALs (Guttman, 1970) in accordance with the APP methodology. Table 2 presents the tolerance limits for horizons 1 through 3.

#### **4.2.3 Alert Levels**

The proposed ALs for each horizon are lower tolerance limits established using the minimum values shown in Table 2. The proposed AL values are shown in Table 3. It is important to note that because the dataset is non-parametric, the proposed ALs represent the minimum detection observed during the referenced period. Unusually wet climatic conditions, or other environmental changes, may further affect the observed bulk EC at the PTF wellfield.

Florence Copper does not propose any changes to the method defined in the APP for bulk EC monitoring or reporting of bulk EC monitoring results.

### **4.3 DETERMINATION OF ALERT LEVEL EXCEEDANCES**

Florence Copper does not propose any changes to the method defined in the APP for determining bulk EC exceedances.

## 5. Closing

Florence Copper has conducted operational bulk EC monitoring at the PTF wellfield in accordance with the provisions outlined in APP No. P-106360 and UIC Permit No. R9UIC-AZ3-FY11-1, and has completed statistical evaluation of the bulk EC data for the purpose of calculating AL values for horizons 1, 2, and 3 which incorporate the observed temporal variability. The AL values proposed in this report were established based on the methods described in Section 2.5.9 of APP No. P-106360 and are suitable for monitoring potential vertical excursions of injected fluid at the LBFU/bedrock contact and within the LBFU. The AL values proposed in this report are compliant with APP No. P-106360 and UIC No. R9UIC-AZ3-FY11-1 and are protective of the LBFU.

Please contact Mark Nicholls at 602-819-0913 with any questions you may have regarding the content of this report.

## 6. References

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## TABLES

**TABLE 1**  
**LOCATION OF BULK ELECTRICAL CONDUCTIVITY SENSORS**  
 FLORENCE COPPER PROJECT  
 FLORENCE, ARIZONA

Well Name	Sensor Name	Depth (feet bgs)	Elevation (feet amsl)
O-01	B-01-BC-01	400	1080
	B-01-BC-02	420	1060
	B-01-BC-03	439	1040
	B-01-BC-04	460	1020
O-02	B-02-BC-01	389	1090
	B-02-BC-02	409	1070
	B-02-BC-03	430	1049
	B-02-BC-04	450	1029
O-03	B-03-BC1-02	350	1128
	B-03-BC1-04	370	1108
	B-03-BC2-02	390	1088
	B-03-BC2-04	410	1068
O-04	B-04-BC-01	350	1127
	B-04-BC-02	370	1107
	B-04-BC-03	390	1087
	B-04-BC-04	410	1067
O-05	B-05-BC-01	344	1133
	B-05-BC-02	364	1113
	B-05-BC-03	384	1093
	B-05-BC-04	404	1073
O-06	B-06-BC-01	324	1153
	B-06-BC-02	343	1134
	B-06-BC-03	364	1113
	B-06-BC-04	384	1093
O-07	B-07-BC1-02	340	1138
	B-07-BC1-04	360	1118
	B-07-BC2-02	380	1098
	B-07-BC2-04	400	1078

**Notes**

*amsl = above mean sea level*

*bgs = below ground surface*

*-Wells O-01 to O-07 are referred to as wells B-01 to B-07 in the design documents and bulk EC datafiles.*

**TABLE 2**  
**TOLERANCE LIMITS FOR HORIZONS 1 THROUGH 3**  
 FLORENCE COPPER PROJECT  
 FLORENCE, ARIZONA

Electrode Pair Horizon	Frequency	Apparent Resistivity ( $\Omega$ -m)				
		Mean	Standard Deviation	Normality	Minimum Detect	Maximum Detect
Horizon 1	1365	12.39	1.305	no	9.67	14.95
Horizon 2	1365	12.52	1.253	no	9.89	14.97
Horizon 3	1365	12.61	1.244	no	10.07	16.61

**Notes**

$\Omega$ -m = ohm-meters

-Horizon 1 includes all electrode pairs approximately 40 feet above the lower basin fill unit (LBFU)/Oxide contact

-Horizon 2 includes all electrode pairs approximately 20 feet above the LBFU/Oxide contact.

-Horizon 3 includes all electrode pairs located at the LBFU/Oxide contact.

-The upper and lower tolerance limits for each horizon are Minimum Detect and Maximum Detect, respectively .



**TABLE 3**  
**PROPOSED ALERT LEVELS FOR HORIZONS 1 THROUGH 3**  
 FLORENCE COPPER PROJECT  
 FLORENCE, ARIZONA

Electrode Pair Horizon	Proposed Alert Level ( $\Omega$ -m)
Horizon 1	9.67
Horizon 2	9.89
Horizon 3	10.07

**Notes**

*$\Omega$ -m: ohm-meters*

*-Horizon 1 includes all electrode pairs approximately 40 feet above the lower basin fill unit (LBFU)/Oxide contact*

*-Horizon 2 includes all electrode pairs approximately 20 feet above the LBFU/Oxide contact.*

*-Horizon 3 includes all electrode pairs located at the LBFU/Oxide contact.*

**Q4 2019 DAILY INJECTION AND RECOVERY  
VOLUMES WITH PERCENT RECOVERY**  
FLORENCE COPPER INC.  
FLORENCE, ARIZONA

**Table 4. October 2019 Daily Injection and Recovery Volumes**

Date	Daily Injection Volume (gallons)	Daily Recovery Volume (gallons)	Ratio PLS/Raff	% Recovery
10/1/2019	360,000	403,200	1.12	112
10/2/2019	358,900	404,400	1.11	111
10/3/2019	359,000	405,800	1.11	111
10/4/2019	359,000	403,400	1.12	112
10/5/2019	359,000	406,200	1.12	112
10/6/2019	351,000	405,600	1.11	111
10/7/2019	347,200	388,200	1.12	112
10/8/2019	347,400	386,300	1.12	112
10/9/2019	347,400	383,800	1.11	111
10/10/2019	331,000	383,200	1.15	115
10/11/2019	319,900	394,700	1.11	111
10/12/2019	321,000	404,300	1.11	111
10/13/2019	320,900	405,600	1.11	111
10/14/2019	320,900	397,900	1.12	112
10/15/2019	321,000	397,900	1.11	111
10/16/2019	321,500	396,800	1.11	111
10/17/2019	321,800	398,200	1.11	111
10/18/2019	321,500	398,700	1.11	111
10/19/2019	324,100	398,500	1.12	112
10/20/2019	318,800	396,200	1.12	112
10/21/2019	318,100	397,400	1.11	111
10/22/2019	319,700	396,900	1.11	111
10/23/2019	320,000	397,900	1.13	113
10/24/2019	319,500	396,400	1.12	112
10/25/2019	321,500	388,800	1.12	112
10/26/2019	319,600	398,200	1.14	114
10/27/2019	321,200	383,100	1.13	113
10/28/2019	321,200	363,000	1.10	110
10/29/2019	320,900	388,200	1.11	111
10/30/2019	321,200	398,600	1.12	112
10/31/2019	317,300	382,200	1.20	120
<b>OCT Averages</b>	<b>330,694</b>	<b>395,148</b>	<b>1.12</b>	<b>112</b>

OCT Averages	Monthly Average Injection Volume (GPM)	Monthly Average Recovery Volume (GPM)
	230	274

**Notes:**

% = percent

GPM = gallons per minute

PLS = pregnant leach solution

Raff = Raffinate

**Q4 2019 DAILY INJECTION AND RECOVERY****VOLUMES WITH PERCENT RECOVERY**

FLORENCE COPPER INC.

FLORENCE, ARIZONA

**Table 5. November 2019 Daily Injection and Recovery Volumes**

<b>Date</b>	<b>Daily Injection Volume (gallons)</b>	<b>Daily Recovery Volume (gallons)</b>	<b>Ratio PLS/Raff</b>	<b>% Recovery</b>
11/1/2019	285,800	345,000	1.11	111
11/2/2019	318,700	382,700	1.10	110
11/3/2019	320,700	384,600	1.11	111
11/4/2019	319,500	386,000	1.21	121
11/5/2019	296,300	360,500	1.22	122
11/6/2019	318,900	386,100	1.21	121
11/7/2019	318,900	388,700	1.22	122
11/8/2019	316,600	386,400	1.22	122
11/9/2019	315,900	381,000	1.21	121
11/10/2019	315,800	384,200	1.22	122
11/11/2019	315,900	388,000	1.23	123
11/12/2019	312,400	385,200	1.23	123
11/13/2019	310,300	385,400	1.24	124
11/14/2019	338,200	387,600	1.15	115
11/15/2019	333,600	388,400	1.16	116
11/16/2019	338,800	387,700	1.14	114
11/17/2019	338,800	387,600	1.14	114
11/18/2019	338,700	388,200	1.15	115
11/19/2019	338,900	387,700	1.14	114
11/20/2019	338,700	387,600	1.14	114
11/21/2019	337,400	387,800	1.15	115
11/22/2019	336,300	388,400	1.15	115
11/23/2019	341,700	387,400	1.13	113
11/24/2019	342,200	387,300	1.13	113
11/25/2019	341,700	384,900	1.13	113
11/26/2019	336,400	380,900	1.13	113
11/27/2019	342,500	384,000	1.12	112
11/28/2019	336,100	381,700	1.14	114
11/29/2019	345,600	388,000	1.12	112
11/30/2019	345,900	387,800	1.12	112
<b>NOV Averages</b>	<b>327,907</b>	<b>383,893</b>	<b>1.16</b>	<b>116</b>

<b>NOV Averages</b>	<b>Monthly Average Injection Volume (GPM)</b>	<b>Monthly Average Recovery Volume (GPM)</b>
	<b>228</b>	<b>267</b>

**Notes:**

% = percent

GPM = gallons per minute

PLS = pregnant leach solution

Raff = Raffinate



**Q4 2019 DAILY INJECTION AND RECOVERY****VOLUMES WITH PERCENT RECOVERY**

FLORENCE COPPER INC.

FLORENCE, ARIZONA

**Table 6. December 2019 Daily Injection and Recovery Volumes**

<b>Date</b>	<b>Daily Injection Volume (gallons)</b>	<b>Daily Recovery Volume (gallons)</b>	<b>Ratio PLS/Raff</b>	<b>% Recovery</b>
12/1/2019	346,100	387,700	1.12	112
12/2/2019	345,500	388,300	1.12	112
12/3/2019	345,800	387,200	1.12	112
12/4/2019	331,700	367,200	1.11	111
12/5/2019	324,900	359,100	1.11	111
12/6/2019	309,500	341,800	1.10	110
12/7/2019	297,100	330,200	1.11	111
12/8/2019	297,000	330,100	1.11	111
12/9/2019	296,400	329,000	1.11	111
12/10/2019	231,700	256,200	1.11	111
12/11/2019	216,300	240,000	1.11	111
12/12/2019	216,200	239,400	1.11	111
12/13/2019	216,400	241,900	1.12	112
12/14/2019	214,600	242,200	1.13	113
12/15/2019	216,100	243,600	1.13	113
12/16/2019	216,200	243,200	1.12	112
12/17/2019	216,100	239,900	1.11	111
12/18/2019	216,300	240,900	1.11	111
12/19/2019	216,400	239,400	1.11	111
12/20/2019	216,200	240,200	1.11	111
12/21/2019	216,200	239,400	1.11	111
12/22/2019	216,700	239,300	1.10	110
12/23/2019	216,300	241,700	1.12	112
12/24/2019	219,900	247,300	1.12	112
12/25/2019	219,900	251,400	1.14	114
12/26/2019	224,160	255,800	1.14	114
12/27/2019	232,272	260,900	1.12	112
12/28/2019	232,272	260,400	1.12	112
12/29/2019	231,264	259,000	1.12	112
12/30/2019	215,500	240,500	1.12	112
12/31/2019	216,300	240,200	1.11	111
<b>DEC Averages</b>	<b>249,267</b>	<b>278,174</b>	<b>1.12</b>	<b>112</b>

<b>DEC Averages</b>	<b>Monthly Average Injection Volume (GPM)</b>	<b>Monthly Average Recovery Volume (GPM)</b>
	<b>173</b>	<b>193</b>

**Notes:**

% = percent

GPM = gallons per minute

PLS = pregnant leach solution

Raff = Raffinate

**Q4 2019 HYDRAULIC GRADIENT, DAILY AVERAGE WATER LEVEL ELEVATIONS,  
OBSERVATION AND RECOVERY WELLS**  
FLORENCE COPPER INC.  
FLORENCE, ARIZONA

Table 7. October 2019 Daily Average Water Level Elevations

Date	R-01	O-01	O-07	R-02	O-01	O-02	R-03	O-02	O-03	R-04	O-03	R-05	O-04	R-06	O-04	O-05	R-07	O-05	O-06	R-08	O-06	O-07	R-09
10/1/2019	1231.25	1244.63	1243.95	1220.77	1244.63	1245.40	1210.75	1245.40	1249.93	1194.09	1249.93	1219.60	1245.36	1205.12	1245.36	1244.45	1241.49	1244.45	1243.20	1215.55	1243.20	1243.95	1225.99
10/2/2019	1229.88	1244.63	1243.95	1218.71	1243.08	1243.83	1208.78	1243.83	1248.75	1191.89	1248.75	1217.42	1244.61	1208.67	1244.61	1243.44	1240.47	1243.44	1241.90	1214.37	1241.90	1240.36	1225.18
10/3/2019	1230.01	1243.08	1240.36	1219.40	1243.06	1243.86	1206.25	1243.86	1248.75	1190.93	1248.75	1218.73	1244.67	1206.68	1244.67	1243.46	1240.49	1243.46	1241.90	1214.38	1241.90	1240.71	1225.54
10/4/2019	1230.62	1243.85	1241.78	1221.98	1243.85	1244.72	1206.80	1244.72	1249.66	1194.03	1249.66	1219.78	1245.26	1207.52	1245.26	1244.09	1241.20	1244.09	1242.59	1214.59	1242.59	1241.78	1227.34
10/5/2019	1229.07	1242.45	1240.15	1218.44	1242.45	1243.21	1204.29	1243.21	1248.05	1189.09	1248.05	1217.69	1244.07	1205.60	1244.07	1243.02	1239.88	1243.02	1241.51	1213.26	1241.51	1240.15	1223.30
10/6/2019	1228.94	1241.57	1239.06	1219.30	1241.57	1242.46	1211.19	1242.46	1246.96	1188.70	1246.96	1211.31	1242.41	1195.27	1242.41	1241.38	1238.44	1241.38	1240.04	1211.93	1240.04	1239.06	1219.89
10/7/2019	1231.42	1243.11	1241.26	1224.27	1243.11	1243.74	1211.48	1243.74	1247.51	1188.66	1247.51	1210.50	1242.95	1191.88	1242.95	1242.26	1240.00	1242.26	1241.29	1216.09	1241.29	1241.26	1221.96
10/8/2019	1232.53	1244.73	1241.64	1225.92	1244.73	1245.06	1212.07	1245.06	1247.73	1188.66	1247.73	1210.01	1243.32	1193.67	1243.32	1242.83	1240.14	1242.83	1242.28	1217.00	1242.28	1241.64	1225.71
10/9/2019	1232.19	1245.35	1242.58	1226.44	1245.35	1245.71	1204.48	1245.71	1248.06	1188.70	1248.06	1209.43	1243.36	1189.15	1243.36	1242.97	1240.67	1242.97	1242.62	1217.07	1242.62	1242.58	1225.24
10/10/2019	1229.78	1244.07	1237.78	1229.17	1244.07	1244.62	1203.61	1244.62	1245.74	1191.34	1245.74	1185.51	1239.36	1185.89	1239.36	1239.54	1237.78	1239.54	1240.00	1214.71	1240.00	1237.78	1228.58
10/11/2019	1225.79	1240.13	1236.42	1227.26	1240.13	1240.50	1207.49	1240.50	1240.47	1189.33	1240.47	1180.41	1234.58	1181.52	1234.58	1235.12	1233.24	1235.12	1235.98	1210.69	1235.98	1236.42	1226.61
10/12/2019	1222.81	1237.04	1233.64	1222.91	1237.04	1237.32	1207.81	1237.32	1237.64	1184.28	1237.64	1180.41	1231.96	1181.52	1231.96	1232.36	1230.65	1232.36	1233.13	1207.33	1233.13	1233.64	1222.94
10/13/2019	1221.66	1236.19	1233.42	1221.61	1236.19	1236.44	1207.15	1236.44	1236.89	1184.44	1236.89	1180.41	1231.17	1180.52	1231.17	1231.53	1229.80	1231.53	1232.29	1206.50	1232.29	1233.42	1221.86
10/14/2019	1222.74	1237.62	1234.48	1222.59	1237.62	1237.44	1208.26	1237.44	1236.91	1184.29	1236.91	1181.32	1232.51	1181.52	1232.51	1232.99	1231.37	1232.99	1233.78	1207.97	1233.78	1234.48	1221.67
10/15/2019	1224.36	1239.26	1235.83	1224.41	1239.26	1238.91	1208.35	1238.91	1238.32	1185.33	1238.32	1182.08	1234.08	1181.52	1234.08	1234.54	1233.05	1234.54	1235.37	1209.52	1235.37	1235.83	1223.37
10/16/2019	1224.26	1239.31	1236.88	1224.97	1239.31	1238.99	1208.35	1238.99	1238.45	1185.33	1238.45	1181.63	1234.03	1181.52	1234.03	1234.43	1232.84	1234.43	1235.29	1209.38	1235.29	1236.88	1223.25
10/17/2019	1223.11	1238.23	1236.04	1222.98	1238.23	1237.83	1207.39	1237.83	1237.12	1184.32	1237.12	1180.88	1232.90	1181.52	1232.90	1233.36	1231.79	1233.36	1234.25	1208.40	1234.25	1236.04	1221.59
10/18/2019	1223.09	1238.35	1236.17	1222.50	1238.35	1237.86	1208.16	1237.86	1237.18	1184.35	1237.18	1180.14	1233.08	1181.52	1233.08	1233.53	1231.59	1233.53	1234.36	1208.19	1234.36	1236.17	1221.04
10/19/2019	1223.41	1238.72	1236.57	1222.70	1238.72	1238.25	1207.23	1238.25	1237.47	1184.26	1237.47	1180.28	1233.69	1181.52	1233.69	1234.01	1232.28	1234.01	1234.80	1208.48	1234.80	1236.57	1221.51
10/20/2019	1223.74	1239.04	1236.93	1222.94	1239.04	1238.61	1202.24	1238.61	1237.97	1184.32	1237.97	1180.59	1234.13	1181.52	1234.13	1234.46	1232.68	1234.46	1235.21	1208.78	1235.21	1236.93	1221.65
10/21/2019	1224.04	1239.39	1237.23	1223.23	1239.39	1238.82	1201.99	1238.82	1238.28	1184.27	1238.28	1181.23	1234.47	1181.03	1234.47	1234.79	1233.02	1234.79	1235.52	1209.67	1235.52	1237.23	1222.22
10/22/2019	1224.06	1239.12	1236.86	1222.63	1239.12	1238.62	1197.59	1238.62	1237.85	1184.12	1237.85	1181.68	1233.96	1180.53	1233.96	1234.33	1232.59	1234.33	1235.14	1209.34	1235.14	1236.86	1222.86
10/23/2019	1222.53	1237.71	1235.39	1220.76	1237.71	1237.17	1203.54	1237.17	1236.23	1184.28	1236.23	1180.19	1232.36	1180.53	1232.36	1232.77	1231.13	1232.77	1233.66	1207.89	1233.66	1235.39	1220.45
10/24/2019	1222.81	1238.11	1235.73	1222.14	1238.11	1237.46	1199.61	1237.46	1236.48	1184.39	1236.48	1180.19	1232.49	1180.53	1232.49	1233.09	1231.37	1233.09	1234.07	1208.86	1234.07	1235.73	1221.14
10/25/2019	1221.46	1236.89	1234.43	1219.59	1236.89	1236.40	1199.23	1236.40	1235.41	1184.37	1235.41	1179.42	1231.35	1180.53	1231.35	1231.71	1230.03	1231.71	1232.62	1206.11	1232.62	1234.43	1219.94
10/26/2019	1222.14	1237.79	1235.50	1220.35	1237.79	1237.09	1208.35	1237.09	1236.02	1184.31	1236.02	1179.42	1232.35	1180.53	1232.35	1231.18	1229.43	1231.18	1232.04	1207.45	1232.04	1235.50	1221.05
10/27/2019	1226.11	1242.08	1239.85	1224.44	1242.08	1241.30	1207.82	1241.30	1240.04	1184.65	1240.04	1179.42	1236.69	1180.53	1236.69	1237.86	NA	1237.86	1238.79	1211.07	1238.79	1239.85	1229.04
10/28/2019	1225.47	1241.47	1238.94	1223.72	1241.47	1240.78	1208.30	1240.78	1239.67	1184.75	1239.67	1179.93	1235.95	1180.53	1235.95	1236.55	1233.40	1236.55	1237.37	1210.02	1237.37	1238.94	1229.47
10/29/2019	1224.25	1240.06	1237.60	1220.88	1240.06	1239.40	1207.94	1239.40	1238.60	1186.65	1238.60	1179.42	1234.73	1180.53	1234.73	1235.07	1233.01	1235.07	1235.83	1210.27	1235.83	1237.60	1228.07
10/30/2019	1227.37	1241.21	1238.80	1223.05	1241.21	1240.50	1197.00	1240.50	1239.29	1184.25	1239.29	1179.42	1235.88	1180.53	1235.88	1236.32	1234.83	1236.32	1237.10	1209.23	1237.10	1238.80	1229.03
10/31/2019	1228.66	1241.86	1239.45	1223.41	1241.86	1241.03	1199.65	1241.03	1239.18	1184.14	1239.18	1179.42	1236.00	1180.53	1236.00	1236.63	1235.35	1236.63	1237.84	1220.64	1237.84	1239.45	1229.21

All measurements in elevation above mean sea level.

NA or NM = Not measured or otherwise not available

No data were available for the following dates/wells:

10/27/2019 R-07 pump replacement.

**Q4 2019 HYDRAULIC GRADIENT, DAILY AVERAGE WATER LEVEL ELEVATIONS,  
OBSERVATION AND RECOVERY WELLS**  
FLORENCE COPPER INC.  
FLORENCE, ARIZONA

**Table 8. November 2019 Daily Average Water Level Elevations**

Date	R-01	O-01	O-07	R-02	O-01	O-02	R-03	O-02	O-03	R-04	O-03	R-05	O-04	R-06	O-04	O-05	R-07	O-05	O-06	R-08	O-06	O-07	R-09
11/1/2019	1231.05	1241.64	1240.36	1222.21	1241.64	1240.21	1198.85	1240.21	1237.43	1184.10	1237.43	1179.80	1237.49	1180.53	1237.49	1238.24	1236.77	1238.24	1239.22	1226.99	1239.22	1240.36	1228.61639
11/2/2019	1229.34	1242.40	1240.04	1223.00	1242.40	1241.53	1200.99	1241.53	1239.47	1185.00	1239.47	1179.46	1236.42	1180.53	1236.42	1237.13	1235.77	1237.13	1238.47	1224.13	1238.47	1240.04	1228.74888
11/3/2019	1229.40	1242.58	1240.05	1224.16	1242.58	1241.67	1199.47	1241.67	1239.44	1183.64	1239.44	1180.34	1236.18	1180.53	1236.18	1236.97	1235.66	1236.97	1238.44	1224.96	1238.44	1240.05	1228.67726
11/4/2019	1228.95	1242.02	1239.66	1222.95	1242.02	1241.14	1199.27	1241.14	1239.00	1183.94	1239.00	1180.99	1235.91	1180.53	1235.91	1236.64	1235.32	1236.64	1238.10	1224.85	1238.10	1239.66	1227.07884
11/5/2019	1229.45	1240.68	1235.62	1220.77	1240.68	1239.78	1199.40	1239.78	1238.08	1184.73	1238.08	1180.18	1236.41	1180.53	1236.41	1237.05	1235.62	1237.05	1238.16	1226.99	1238.16	1235.62	1228.02995
11/6/2019	1232.24	1241.48	1239.43	1221.32	1241.48	1240.03	1203.64	1240.03	1236.22	1184.56	1236.22	1179.42	1234.90	1180.53	1234.90	1235.95	1234.81	1235.95	1237.76	1228.36	1237.76	1239.43	1226.95291
11/7/2019	1233.63	1241.93	1239.75	1221.56	1241.93	1240.41	1195.41	1240.41	1236.46	1184.33	1236.46	1179.42	1235.02	1180.53	1235.02	1236.03	1234.78	1236.03	1237.93	1228.65	1237.93	1239.75	1225.96299
11/8/2019	1233.69	1241.99	1239.85	1221.46	1241.99	1240.47	1182.55	1240.47	1236.49	1184.26	1236.49	1179.42	1235.53	1180.53	1235.53	1236.31	1235.01	1236.31	1238.05	1228.72	1238.05	1239.85	1224.6649
11/9/2019	1234.43	1243.02	1240.65	1223.52	1243.02	1241.53	1185.24	1241.53	1237.59	1184.23	1237.59	1179.42	1236.35	1180.53	1236.35	1237.04	1235.68	1237.04	1238.88	1229.79	1238.88	1240.65	1210.45972
11/10/2019	1234.28	1242.82	1240.42	1223.59	1242.82	1241.30	1184.89	1241.30	1237.22	1184.19	1237.22	1179.42	1236.06	1180.53	1236.06	1236.78	1235.41	1236.78	1238.66	1229.55	1238.66	1240.42	1202.16001
11/11/2019	1233.12	1241.55	1239.32	1220.43	1241.55	1240.01	1181.74	1240.01	1235.85	1184.30	1235.85	1179.42	1234.79	1180.53	1234.79	1235.63	1234.33	1235.63	1237.52	1228.14	1237.52	1239.32	1199.21229
11/12/2019	1231.68	1240.13	1237.94	1219.57	1240.13	1238.57	1181.87	1238.57	1234.24	1184.30	1234.24	1179.42	1233.28	1180.53	1233.28	1234.12	1232.85	1234.12	1236.09	1226.76	1236.09	1237.94	1197.07918
11/13/2019	1230.77	1238.69	1236.95	1217.63	1238.69	1236.85	1180.88	1236.85	1232.86	1184.13	1232.86	1179.42	1232.57	1180.53	1232.57	1233.34	1231.72	1233.34	1235.20	1225.72	1235.20	1236.95	1193.84662
11/14/2019	1231.95	1240.12	1238.20	1218.00	1240.12	1238.55	1181.17	1238.55	1234.61	1184.27	1234.61	1179.42	1233.87	1180.53	1233.87	1234.53	1232.87	1234.53	1236.33	1226.23	1236.33	1238.20	1194.70315
11/15/2019	1233.17	1241.32	1240.00	1211.30	1241.32	1240.14	1181.08	1240.14	1239.38	1184.14	1239.38	1180.28	1237.64	1180.53	1237.64	1237.53	1235.46	1237.53	1238.60	1223.35	1238.60	1240.00	1196.26694
11/16/2019	1234.66	1242.82	1241.60	1212.57	1242.82	1241.77	1182.29	1241.77	1241.57	1184.30	1241.57	1182.06	1239.56	1180.53	1239.56	1239.34	1237.12	1239.34	1240.25	1224.95	1240.25	1241.60	1197.21768
11/17/2019	1235.38	1244.00	1242.23	1218.42	1244.00	1242.89	1187.78	1242.89	1242.04	1184.51	1242.04	1180.75	1239.63	1180.53	1239.63	1239.55	1237.35	1239.55	1240.72	1225.52	1240.72	1242.23	1196.98496
11/18/2019	1235.93	1244.82	1242.65	1222.21	1244.82	1243.72	1196.78	1243.72	1242.47	1184.25	1242.47	1179.42	1239.17	1180.53	1239.17	1239.72	1237.56	1239.72	1241.11	1225.96	1241.11	1242.65	1198.142
11/19/2019	1236.36	1245.22	1243.15	1222.50	1245.22	1244.19	1196.72	1244.19	1243.02	1184.35	1243.02	1179.42	1239.71	1180.53	1239.71	1240.19	1238.00	1240.19	1241.52	1226.43	1241.52	1243.15	1197.07098
11/20/2019	1237.36	1246.12	1244.21	1223.39	1246.12	1245.26	1194.89	1245.26	1244.18	1184.29	1244.18	1179.42	1240.80	1180.53	1240.80	1241.27	1239.03	1241.27	1242.57	1227.46	1242.57	1244.21	1197.78845
11/21/2019	1238.05	1246.81	1244.89	1223.73	1246.81	1245.94	1194.25	1245.94	1244.94	1184.11	1244.94	1179.42	1241.59	1180.53	1241.59	1241.98	1239.75	1241.98	1243.28	1228.26	1243.28	1244.89	1198.39403
11/22/2019	1238.31	1247.11	1245.47	1218.06	1247.11	1246.38	1195.39	1246.38	1246.66	1184.41	1246.66	1179.42	1243.27	1180.53	1243.27	1242.75	1240.47	1242.75	1243.98	1231.75	1243.98	1245.47	1206.49
11/23/2019	1238.73	1247.30	1245.73	1219.63	1247.30	1246.35	1208.46	1246.35	1246.16	1184.40	1246.16	1179.42	1243.84	1180.53	1243.84	1243.27	1240.95	1243.27	1244.38	1232.02	1244.38	1245.73	1208.84
11/24/2019	1238.97	1247.62	1246.13	1219.77	1247.62	1246.59	1209.97	1246.59	1246.15	1184.22	1246.15	1178.29	1244.38	1173.64	1244.38	1243.83	1241.50	1243.83	1244.88	1232.35	1244.88	1246.13	1209.60502
11/25/2019	1239.38	1247.77	1246.17	1219.70	1247.77	1246.74	1180.90	1246.74	1244.49	1184.39	1244.49	1178.61	1244.45	1161.68	1244.45	1243.84	1241.55	1243.84	1244.86	1232.43	1244.86	1246.17	1209.13503
11/26/2019	1239.83	1248.13	1246.82	1216.90	1248.13	1246.96	1182.46	1246.96	NA	1183.20	NA	1178.36	1245.17	1163.30	1245.17	1244.67	1242.65	1244.67	1245.62	1231.61	1245.62	1246.82	1209.91647
11/27/2019	1240.04	1248.62	1247.24	1215.34	1248.62	1247.38	1184.63	1247.38	NA	1176.84	NA	1178.46	1245.70	1163.01	1245.70	1245.16	1242.61	1245.16	1246.06	1231.05	1246.06	1247.24	1210.02399
11/28/2019	1240.08	1248.39	1247.03	1219.94	1248.39	1247.08	1184.21	1247.08	NA	1176.75	NA	1176.77	1245.43	1166.49	1245.43	1244.98	1242.31	1244.98	1245.88	1234.03	1245.88	1247.03	1208.97721
11/29/2019	1240.76	1249.28	1247.91	1219.91	1249.28	1247.86	1180.59	1247.86	NA	1169.08	NA	1178.64	1246.15	1161.03	1246.15	1245.60	1242.98	1245.60	1246.55	1234.46	1246.55	1247.91	1211.34012
11/30/2019	1241.01	1249.56	1248.15	1220.89	1249.56	1248.15	1180.60	1248.15	NA	1170.53	NA	1179.71	1246.13	1160.56	1246.13	1245.72	1243.18	1245.72	1246.89	1234.96	1246.89	1248.15	1211.44327

All measurements in elevation above mean sea level.

NA or NM = Not measured or otherwise not available

No data were available for the following dates/wells:

11/26/2019 - 12/5/2019: O-03 Bladder pump/tubing retrieval



**Q4 2019 HYDRAULIC GRADIENT, DAILY AVERAGE WATER LEVEL ELEVATIONS,  
OBSERVATION AND RECOVERY WELLS**  
FLORENCE COPPER INC.  
FLORENCE, ARIZONA

**Table 9. December 2019 Daily Average Water Level Elevations**

Date	R-01	O-01	O-07	R-02	O-01	O-02	R-03	O-02	O-03	R-04	O-03	R-05	O-04	R-06	O-04	O-05	R-07	O-05	O-06	R-08	O-06	O-07	R-09
12/1/2019	1240.76	1249.28	1247.91	1219.91	1249.28	1247.86	1180.59	1247.86	NA	1169.08	NA	1178.64	1246.15	1161.03	1246.15	1245.60	1242.98	1245.60	1246.55	1234.46	1246.55	1247.91	1211.34012
12/2/2019	1241.17	1249.28	1247.91	1220.38	1249.80	1248.34	1176.43	1248.34	NA	1156.82	NA	1176.45	1246.41	1160.01	1246.41	1246.16	1243.43	1246.16	1247.08	1235.30	1247.08	1248.36	1211.14804
12/3/2019	1241.47	1249.80	1248.36	1220.52	1250.20	1248.73	1177.09	1248.73	NA	1153.59	NA	1175.85	1246.64	1159.93	1246.64	1246.45	1243.75	1246.45	1247.38	1235.73	1247.38	1248.68	1211.57
12/4/2019	1239.81	1246.39	1247.66	1216.50	1246.39	1245.95	1193.40	1245.95	NA	1153.07	NA	1178.17	1248.59	1187.08	1248.59	1247.86	1244.48	1247.86	1247.66	1235.40	1247.66	1247.66	1212.77689
12/5/2019	1239.43	1245.60	1247.57	1215.69	1245.60	1245.39	1198.78	1245.39	NA	1151.96	NA	1177.64	1248.99	1197.13	1248.99	1248.20	1244.72	1248.20	1247.78	1235.45	1247.78	1247.57	1212.50663
12/6/2019	1241.33	1246.01	1248.28	1215.54	1246.01	1245.55	1189.64	1245.55	1246.33	1168.73	1246.33	1176.87	1249.64	1203.76	1249.64	1249.22	1246.54	1249.22	1248.71	1236.30	1248.71	1248.28	1204.92421
12/7/2019	1242.46	1245.91	1248.35	1214.86	1245.91	1245.28	1182.85	1245.28	1246.20	1144.38	1246.20	1175.77	1249.84	1211.96	1249.84	1249.60	1247.26	1249.60	1248.96	1236.59	1248.96	1248.35	1198.60762
12/8/2019	1242.55	1246.00	1248.54	1214.67	1246.00	1245.41	1182.14	1245.41	1246.60	1142.07	1246.60	1175.43	1249.98	1211.49	1249.98	1249.66	1247.42	1249.66	1249.14	1236.87	1249.14	1248.54	1198.88845
12/9/2019	1242.45	1245.94	1248.44	1214.43	1245.94	1245.36	1181.42	1245.36	1246.60	1139.44	1246.60	1174.56	1249.81	1210.81	1249.81	1249.62	1247.43	1249.62	1249.01	1236.94	1249.01	1248.44	1198.05416
12/10/2019	1243.30	1247.27	1247.78	1220.38	1247.27	1246.86	1196.22	1246.86	NA	1173.63	NA	1208.17	1250.55	1210.04	1250.55	1250.09	1247.78	1250.09	1249.46	1238.59	1249.46	1247.78	1210.00
12/11/2019	1244.26	1248.43	1249.93	1222.34	1248.43	1247.18	1197.77	1247.18	NA	1177.08	NA	1214.90	1250.59	1210.18	1250.59	1250.17	1247.83	1250.17	1249.85	1239.24	1249.85	1249.93	1211.16736
12/12/2019	1244.71	1249.05	1250.35	1222.80	1249.05	1247.79	1197.99	1247.79	NA	1177.53	NA	1215.26	1251.02	1210.15	1251.02	1250.63	1248.30	1250.63	1250.34	1239.94	1250.34	1250.35	1211.81376
12/13/2019	1245.20	1250.71	1250.40	1225.22	1250.71	1250.09	1196.55	1250.09	1261.84	1178.29	1261.84	1215.67	1250.97	1208.69	1250.97	1250.29	1247.86	1250.29	1250.06	1239.52	1250.06	1250.40	1211.8349
12/14/2019	1245.26	1251.65	1250.18	1226.77	1251.65	1251.44	1198.39	1251.44	1261.95	1178.77	1261.95	1215.78	1250.71	1206.61	1250.71	1249.80	1247.29	1249.80	1249.51	1239.09	1249.51	1250.18	1212.27519
12/15/2019	1244.81	1252.06	1250.52	1227.93	1252.06	1251.88	1198.94	1251.88	1262.29	1178.08	1262.29	1215.95	1251.02	1208.02	1251.02	1250.14	1247.52	1250.14	1249.68	1239.61	1249.68	1250.52	1212.46782
12/16/2019	1245.87	1252.26	1250.84	1226.98	1252.26	1251.99	1196.88	1251.99	1261.48	1166.94	1261.48	1215.41	1251.15	1207.54	1251.15	1250.36	1247.95	1250.36	1250.00	1240.27	1250.00	1250.84	1212.50572
12/17/2019	1246.76	1252.73	1251.66	1226.90	1252.73	1252.03	1197.83	1252.03	1261.10	1173.80	1261.10	1216.06	1251.11	1209.49	1251.11	1251.17	1249.39	1251.17	1251.33	1242.89	1251.33	1251.66	1211.97887
12/18/2019	1247.23	1253.07	1252.01	1226.90	1253.07	1252.19	1198.38	1252.19	NA	1172.86	NA	1213.21	1251.24	1209.56	1251.24	1251.65	1250.18	1251.65	1251.87	1244.41	1251.87	1252.01	1211.4287
12/19/2019	1247.06	1252.82	1251.74	1226.45	1252.82	1251.87	1199.16	1251.87	NA	1171.72	NA	1212.62	1250.97	1209.93	1250.97	1251.44	1250.03	1251.44	1251.60	1244.55	1251.60	1251.74	1211.10576
12/20/2019	1245.50	1250.77	1250.31	1223.92	1250.77	1249.89	1196.37	1249.89	1254.32	1170.84	1254.32	1212.48	1250.40	1207.33	1250.40	1250.53	1248.86	1250.53	1250.26	1243.17	1250.26	1250.31	1210.82256
12/21/2019	1243.97	1249.09	1248.84	1222.01	1249.09	1248.27	1195.30	1248.27	1246.50	1167.59	1246.50	1210.94	1248.82	1206.20	1248.82	1249.05	1247.46	1249.05	1248.79	1241.67	1248.79	1248.84	1209.54743
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12/23/2019	1242.20	1247.55	1247.42	1219.77	1247.55	1246.65	1190.12	1246.65	1244.96	1163.29	1244.96	1208.96	1247.24	1203.30	1247.24	1247.54	1245.79	1247.54	1247.30	1240.49	1247.30	1247.42	1208.38
12/24/2019	1241.09	1247.10	1247.14	1219.30	1247.10	1246.37	1186.69	1246.37	1245.68	1162.09	1245.68	1208.90	1247.21	1200.82	1247.21	1247.38	1245.52	1247.38	1247.08	1240.35	1247.08	1247.14	1208.80845
12/25/2019	1241.06	1246.95	1247.03	1218.28	1246.95	1246.18	1184.96	1246.18	1246.12	1160.74	1246.12	1208.68	1246.97	1194.56	1246.97	1247.16	1245.34	1247.16	1246.99	1240.50	1246.99	1247.03	1208.46949
12/26/2019	1240.47	1247.05	1247.12	1218.11	1247.05	1246.22	1181.38	1246.22	1247.06	1158.71	1247.06	1209.37	1247.27	1194.98	1247.27	1247.37	1245.46	1247.37	1247.10	1239.71	1247.10	1247.12	1209.03498
12/27/2019	1240.55	1248.71	1248.73	1220.43	1248.71	1248.04	1189.23	1248.04	1250.15	1156.77	1250.15	1210.86	1249.37	1198.55	1249.37	1249.25	1247.18	1249.25	1248.78	1238.40	1248.78	1248.73	1210.96088
12/28/2019	1241.79	1249.92	1249.96	1221.48	1249.92	1249.23	1190.14	1249.23	1251.56	1156.04	1251.56	1211.78	1250.60	1200.46	1250.60	1250.46	1248.38	1250.46	1250.01	1239.84	1250.01	1249.96	1212.46089
12/29/2019	1242.94	1250.66	1250.75	1222.07	1250.66	1249.96	1187.86	1249.96	1252.66	1156.94	1252.66	1212.20	1251.25	1199.87	1251.25	1251.16	1249.12	1251.16	1250.82	1241.32	1250.82	1250.75	1212.97553
12/30/2019	1245.91	1251.14	1251.11	1222.37	1251.14	1250.44	1194.65	1250.44	1252.61	1160.16	1252.61	1211.97	1251.24	1206.73	1251.24	1251.42	1249.57	1251.42	1251.16	1243.56	1251.16	1251.11	1212.00
12/31/2019	1244.15	1251.49	1251.40	1220.98	1251.49	1250.64	1194.11	1250.64	1253.68	1161.36	1253.68	1211.88	1251.57	1204.64	1251.57	1251.70	1249.82	1251.70	1251.44	1244.48	1251.44	1251.40	1212.09195

All measurements in elevation above mean sea level.

NA or NM = Not measured or otherwise not available

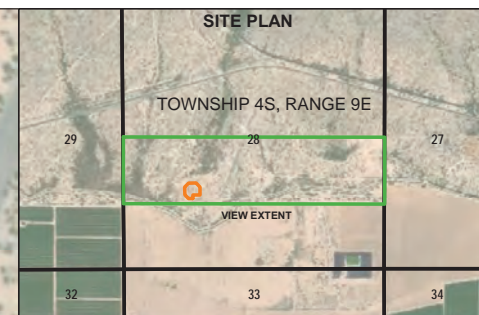
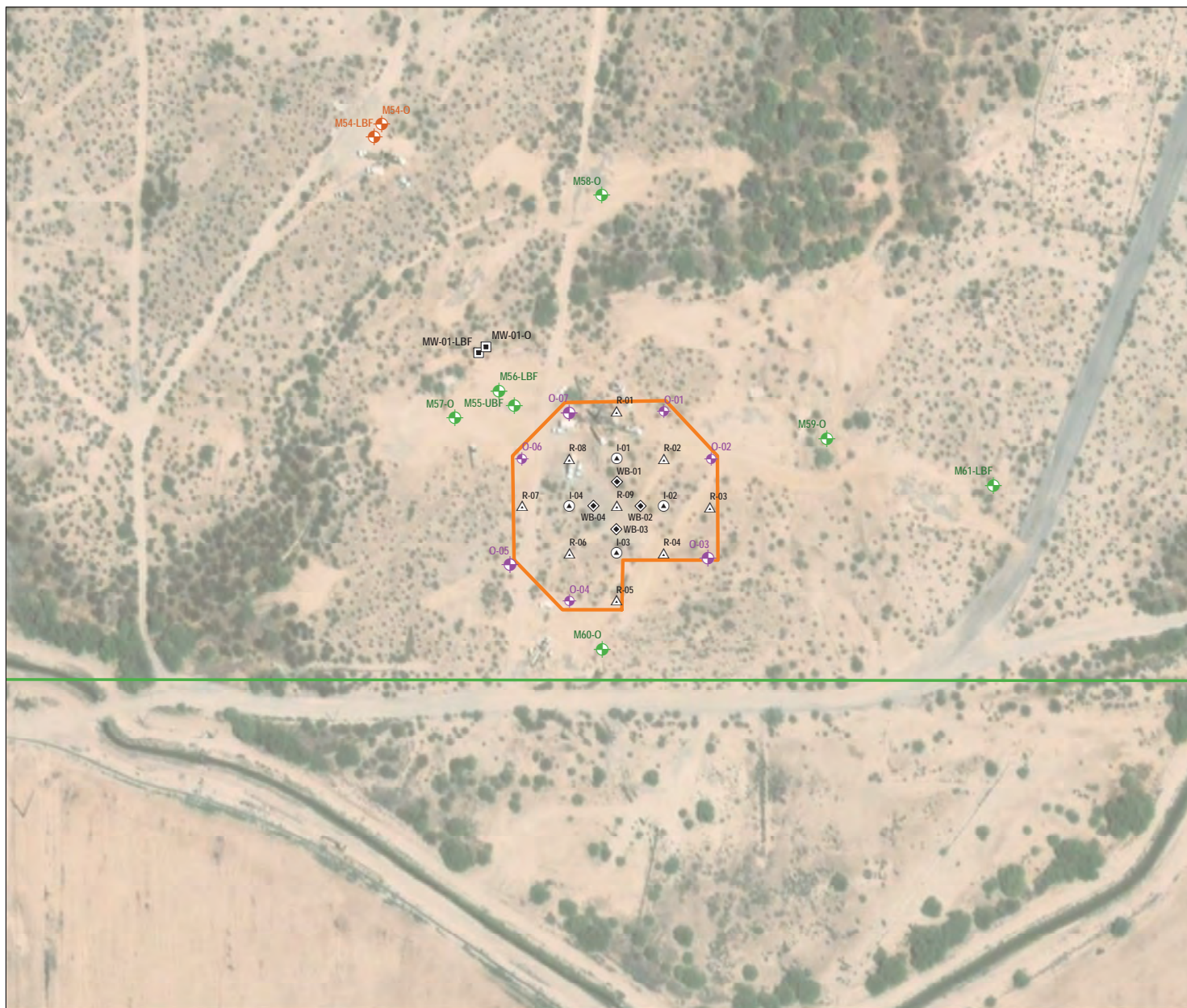
No data were available for the following dates/wells:

11/26/2019 - 12/5/2019: O-03 Bladder pump/tubing retrieval

12/10/2019 - 12/12/2019: O-03 Bladder pump/tubing retrieval

12/18/2019 - 12/19/2019: O-03 Bladder pump/tubing retrieval and redevelopment

## FIGURES



#### LEGEND

- OBSERVATION WELL
- SUPPLEMENTAL MONITORING WELL
- POINT-OF-COMPLIANCE WELL

#### PTF WELLS

- INJECTION
- RECOVERY
- WESTBAY WELL
- OPERATIONAL MONITORING

PTF WELL FIELD

STATE LAND LEASE

#### NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI



0 150 300  
SCALE IN FEET

**HALEY  
ALDRICH**

FLORENCE COPPER PROJECT  
FLORENCE, ARIZONA

PTF Well Field Site Map

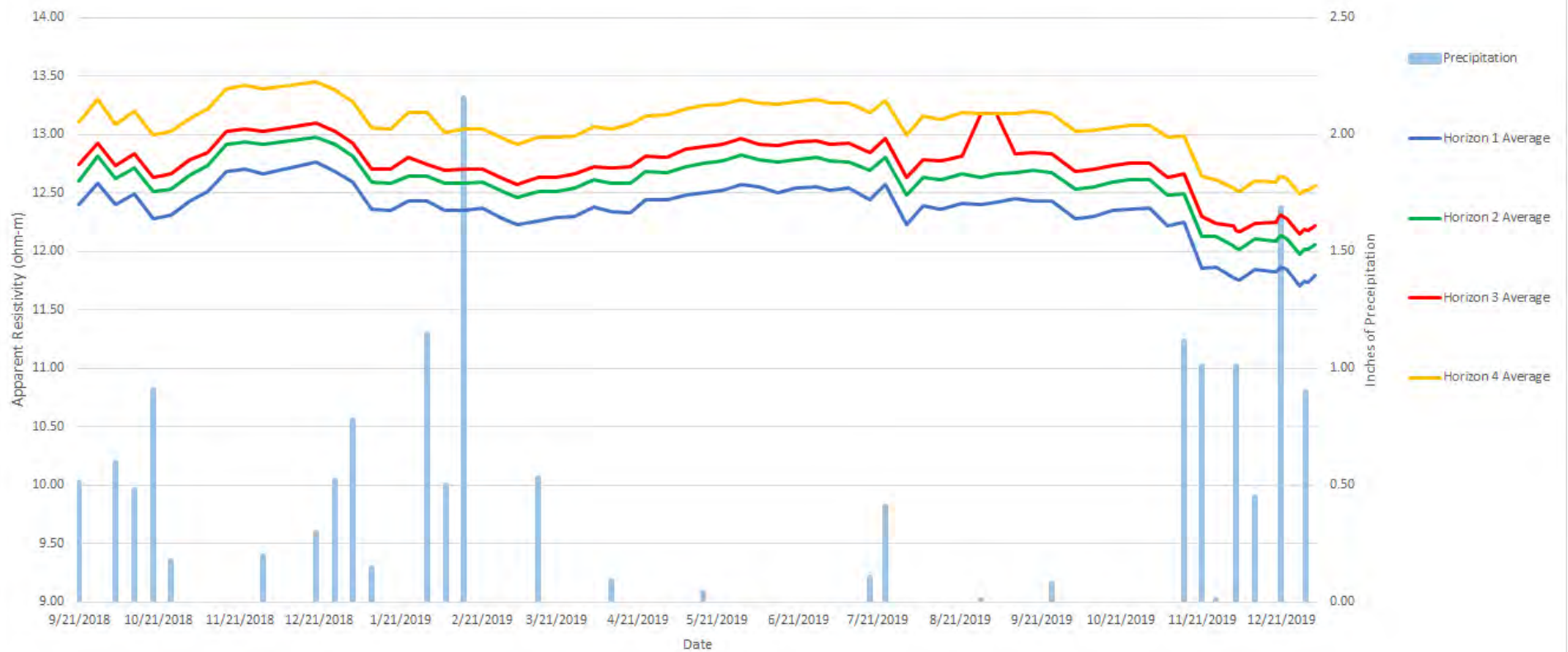
**FLORENCE  
COPPER INC.**

JANUARY 2020

FIGURE 1



Time Series Plot of Bulk EC and Precipitation at Observation Well O-01 on All Monitoring Horizons



HALEY  
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FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

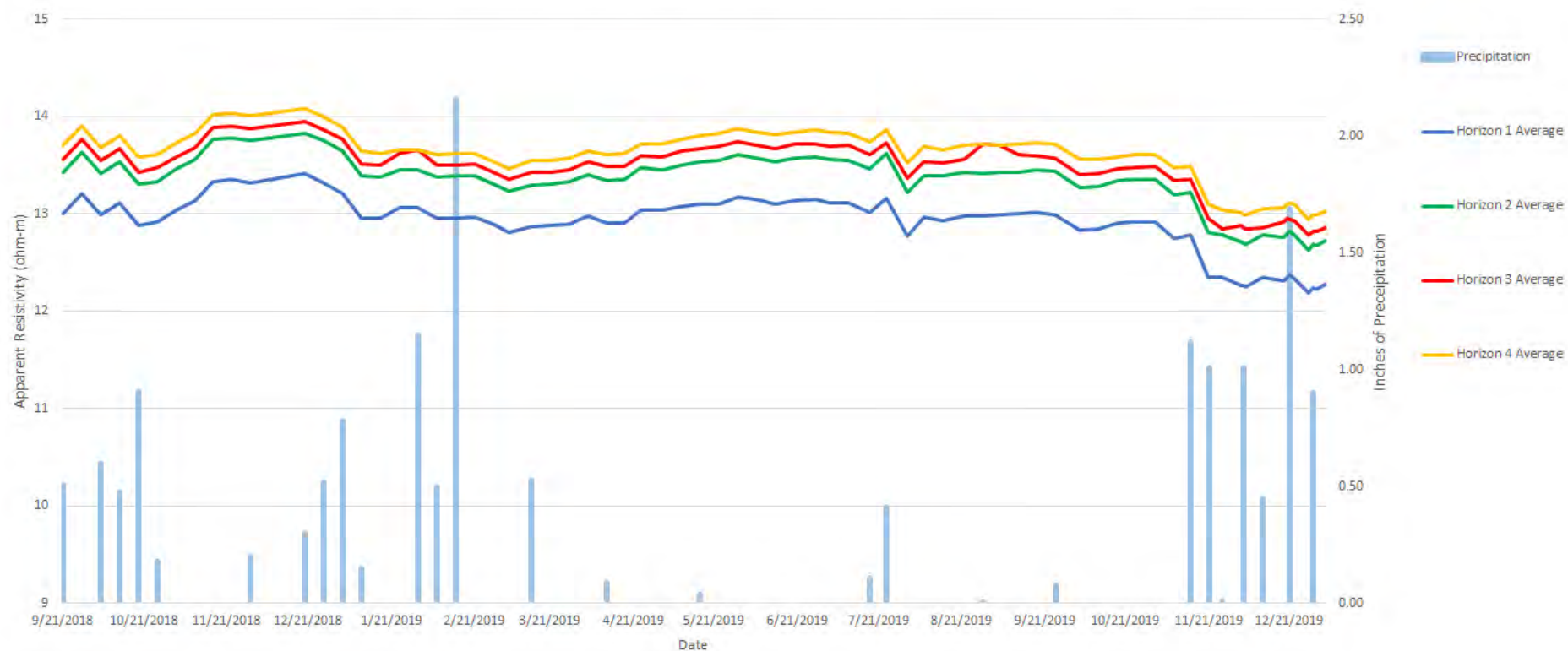
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-01 ON ALL MONITORING  
HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 2

Time Series Plot of Bulk EC and Precipitation at Observation Well O-02 on All Monitoring Horizons



HALEY  
ALDRICH

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

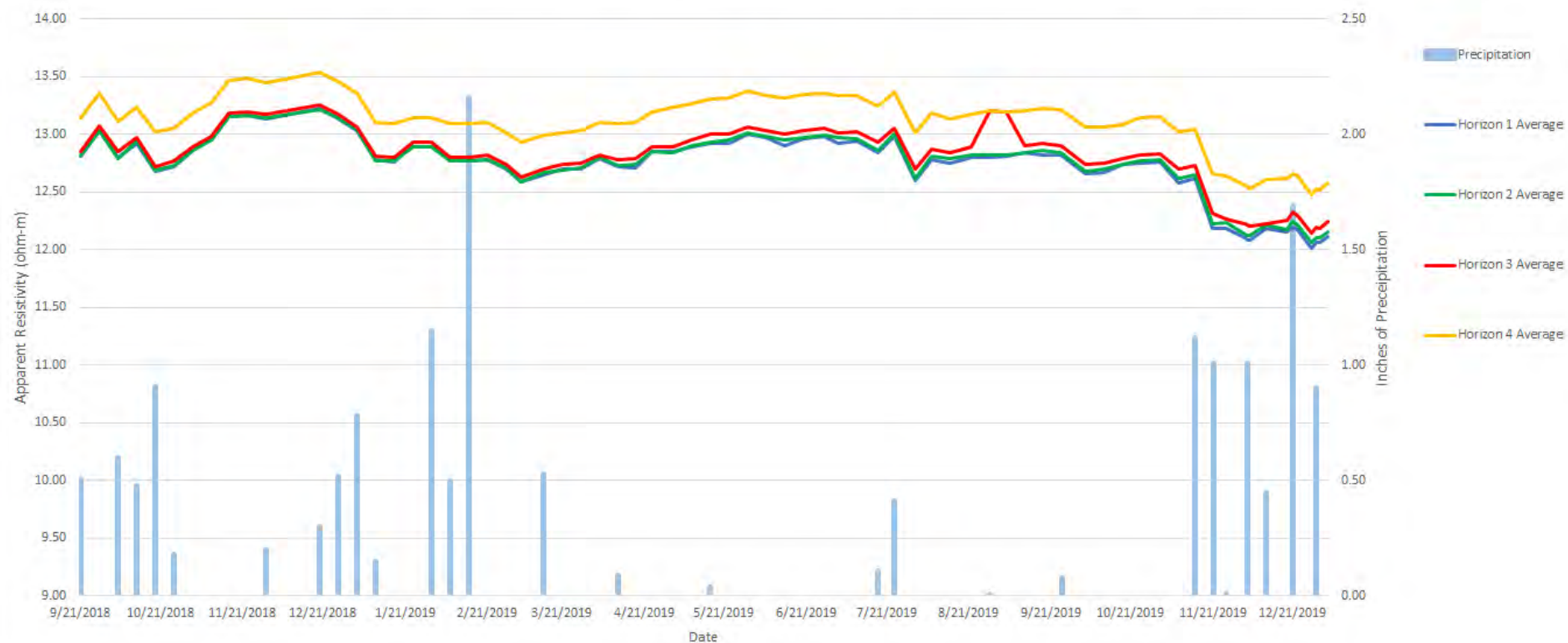
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-02 ON ALL MONITORING  
HORIZONS

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FIGURE 3

Time Series Plot of Bulk EC and Precipitation at Observation Well O-03 on All Monitoring Horizons



**HALEY  
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PTF WELLFIELD  
FLORENCE, ARIZONA

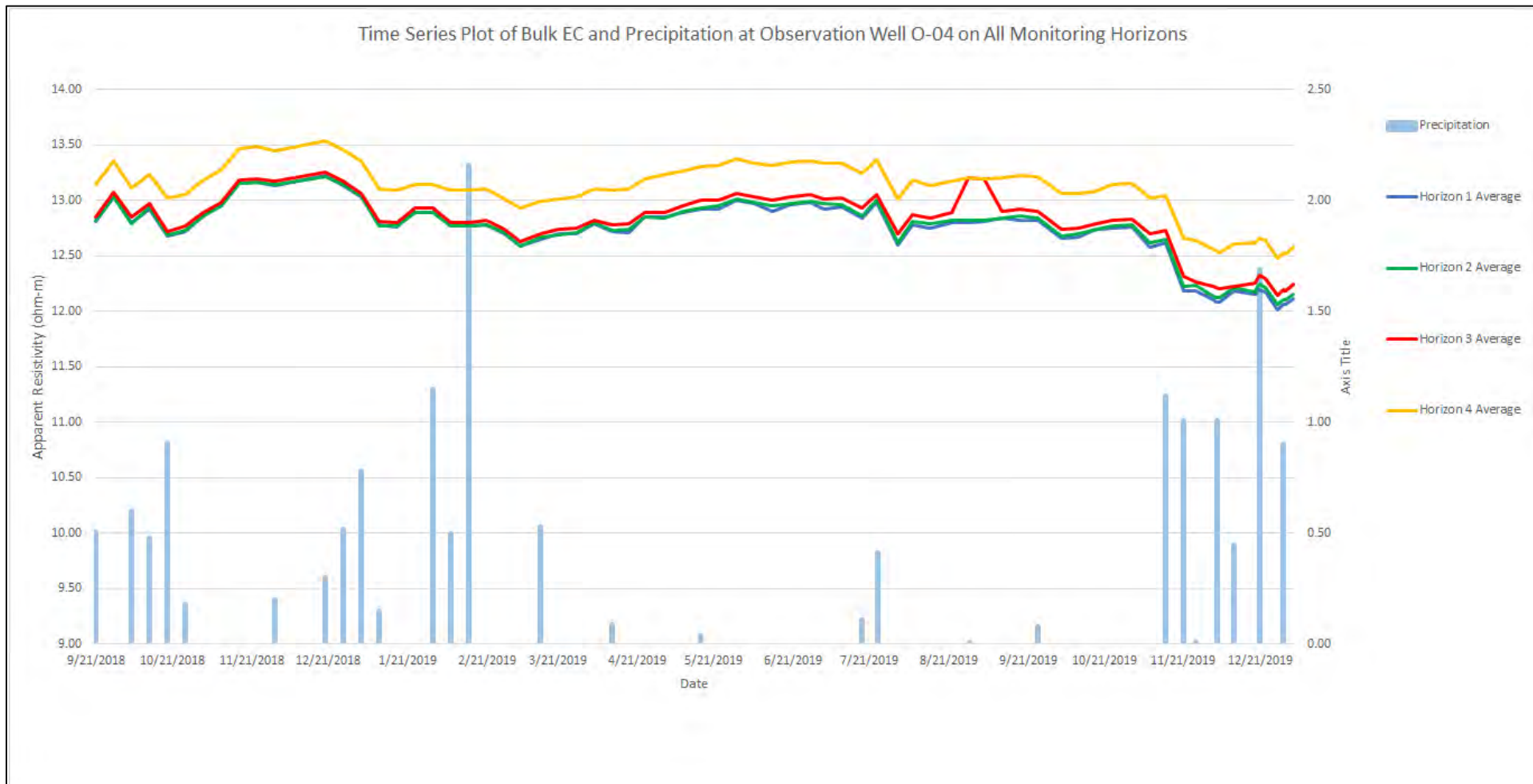
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-03 ON ALL MONITORING  
HORIZONS

FLORENCE  
COPPER INC.

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FIGURE 4





**HALEY  
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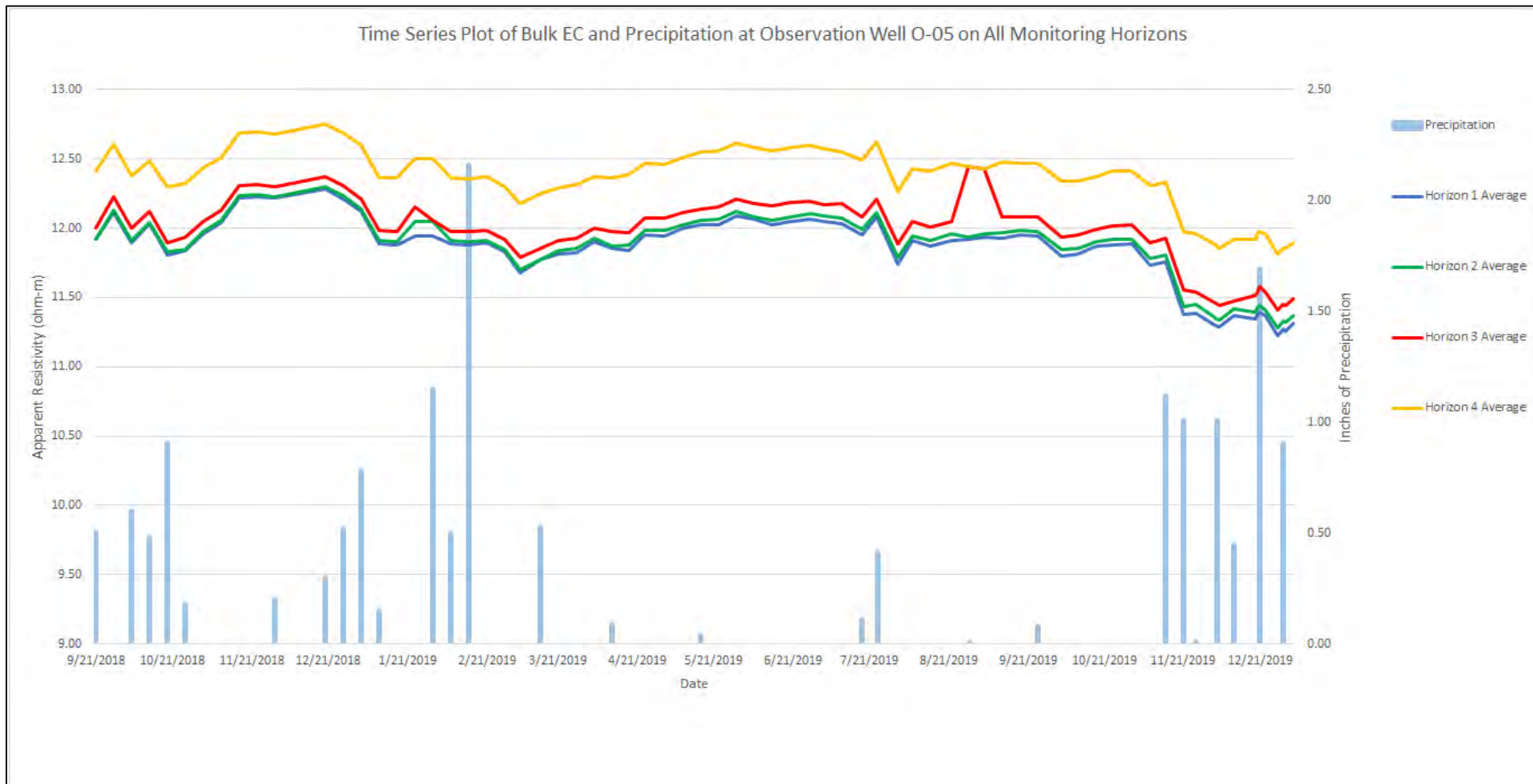
FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-04 ON ALL MONITORING  
HORIZONS

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FIGURE 5



**HALEY  
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PTF WELLFIELD  
FLORENCE, ARIZONA

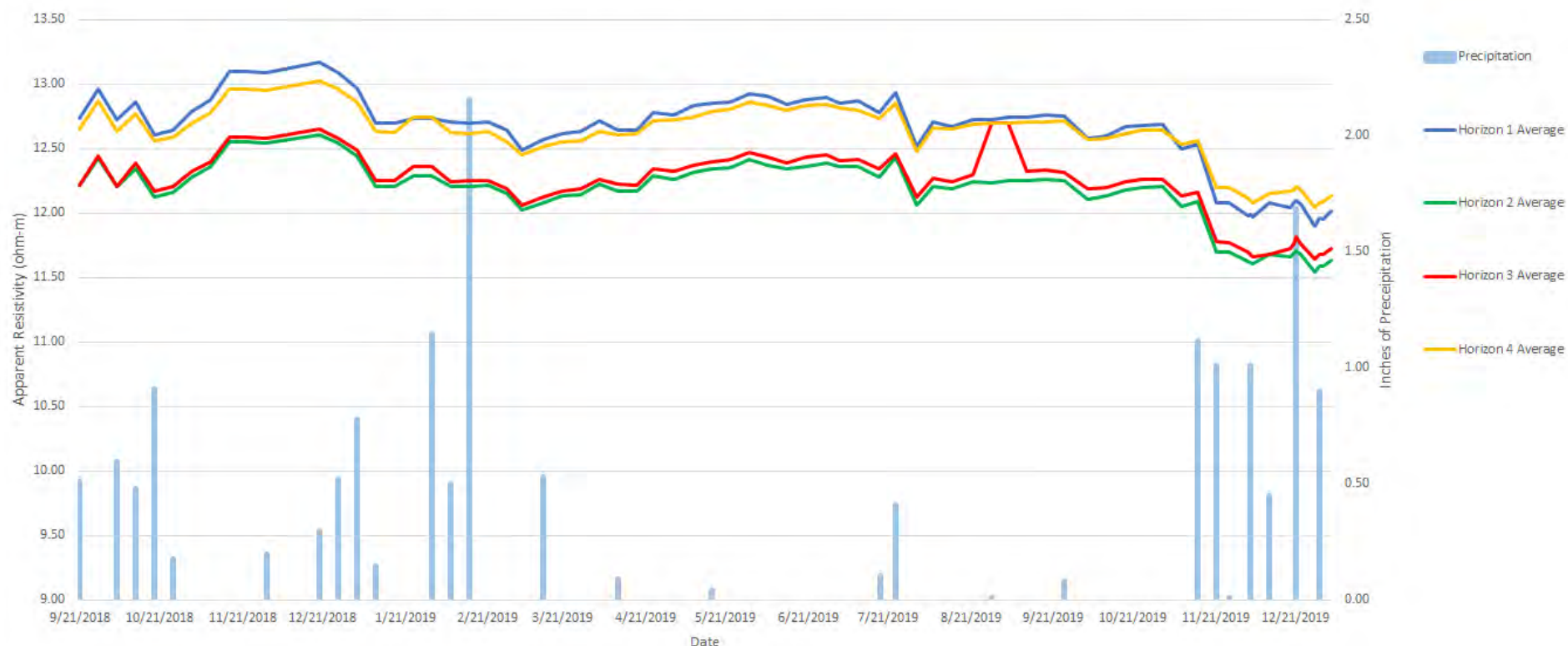
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-05 ON ALL MONITORING  
HORIZONS

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FIGURE 6

Time Series Plot of Bulk EC and Precipitation at Observation Well O-06 on All Monitoring Horizons



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ALDRICH**

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

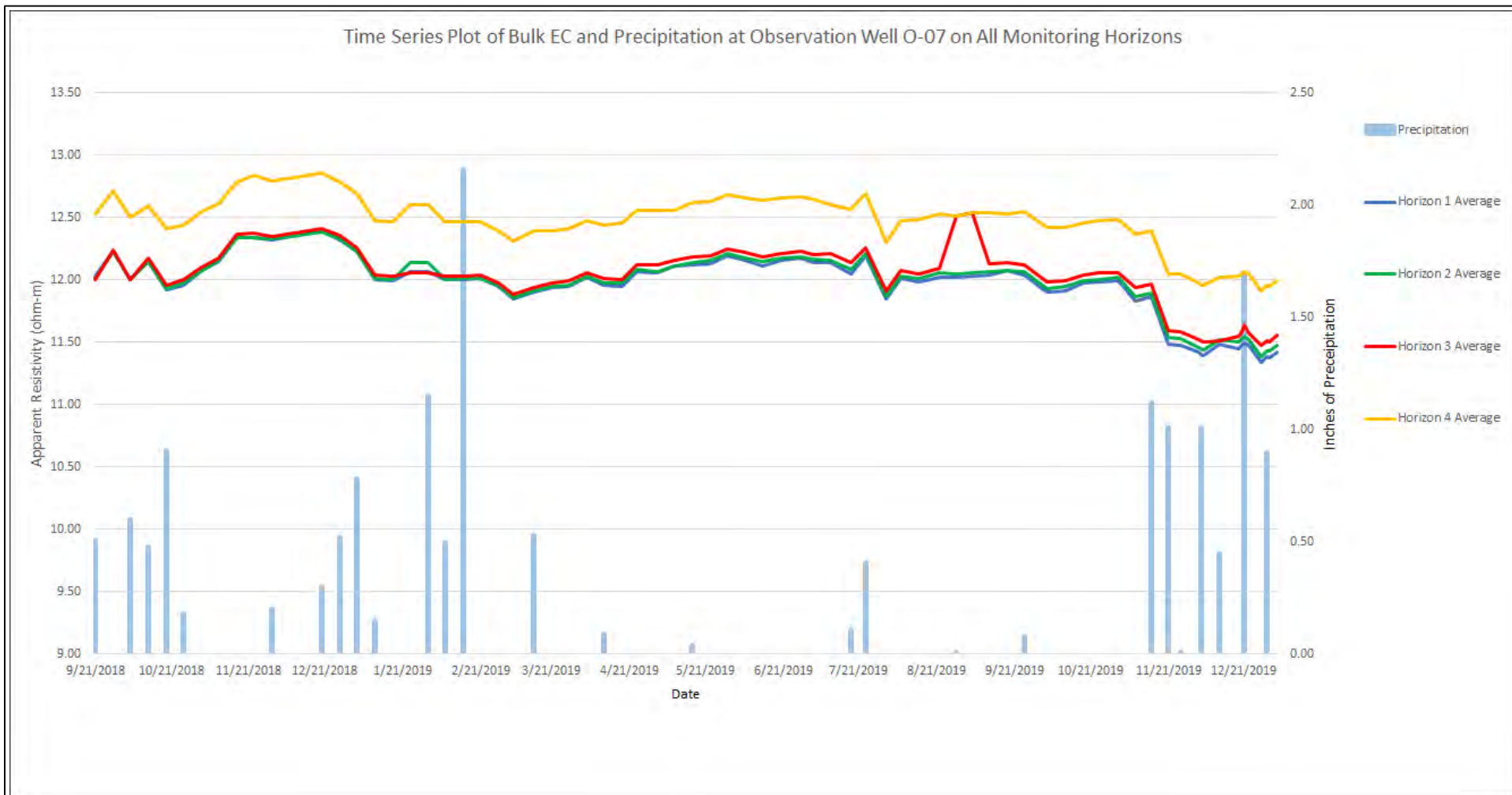
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-06 ON ALL MONITORING  
HORIZONS

FLORENCE  
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JANUARY 2020

FIGURE 7





**HALEY  
ALDRICH**

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

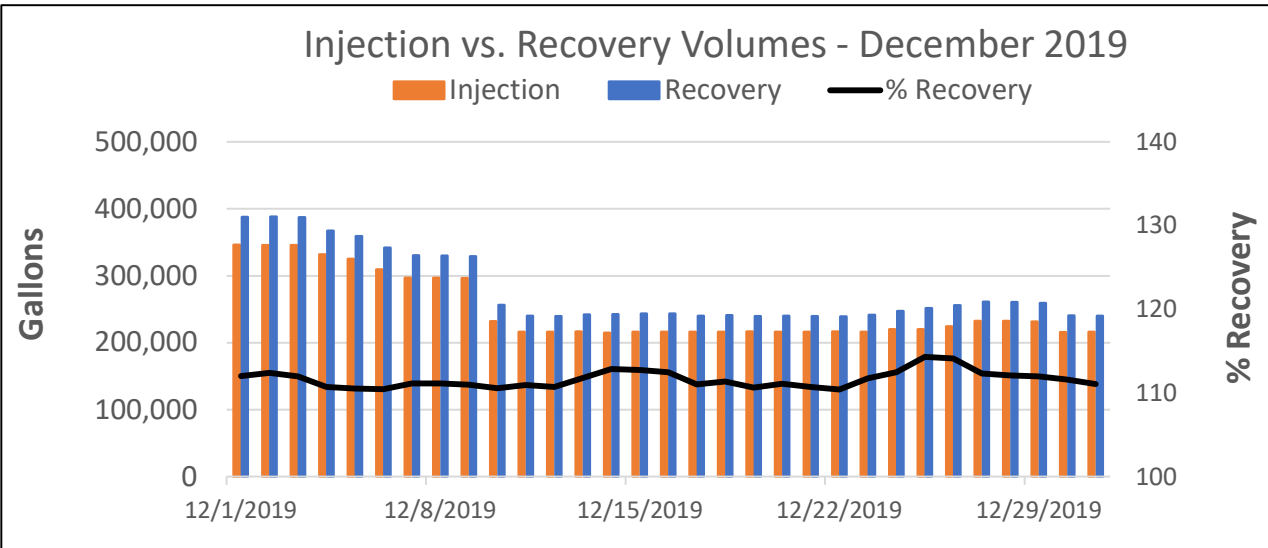
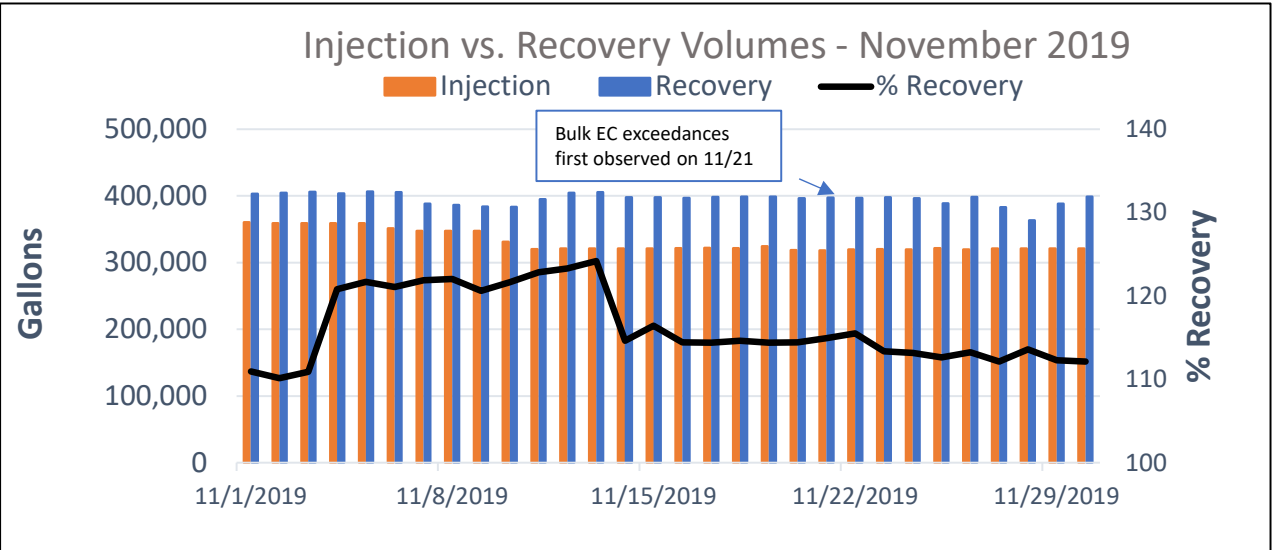
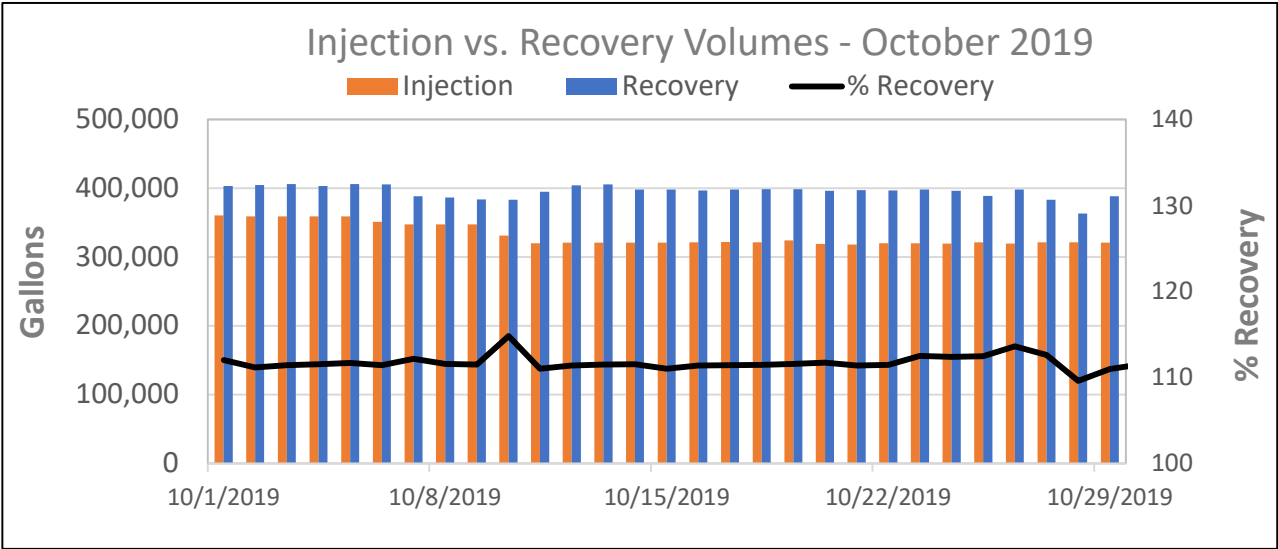
TIME SERIES PLOT OF BULK EC AND  
PRECIPITATION AT OBSERVATION  
WELL O-07 ON ALL MONITORING  
HORIZONS

FLORENCE  
COPPER INC.

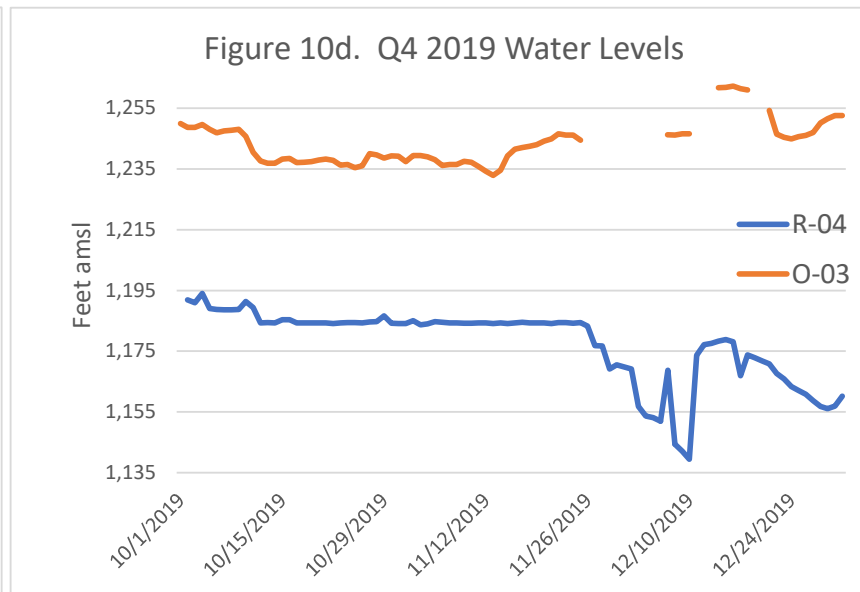
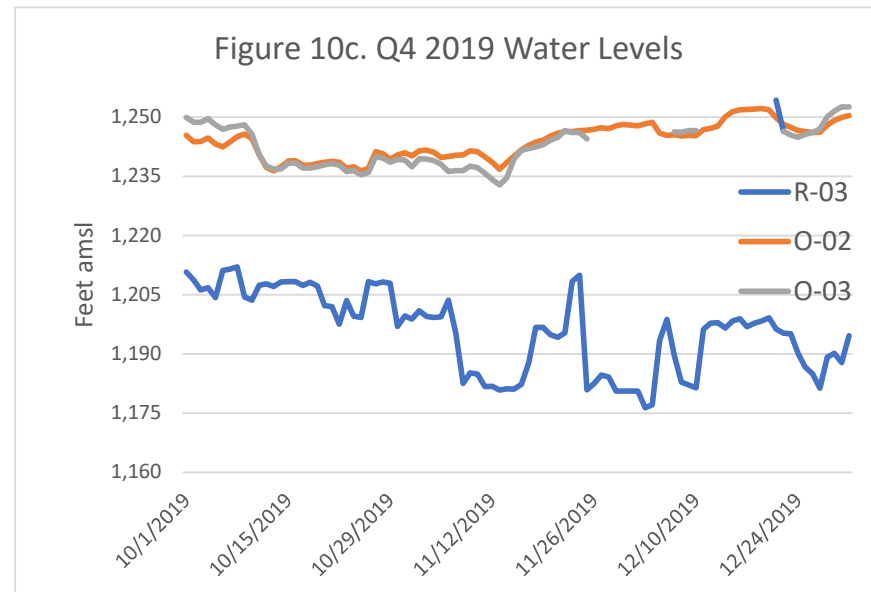
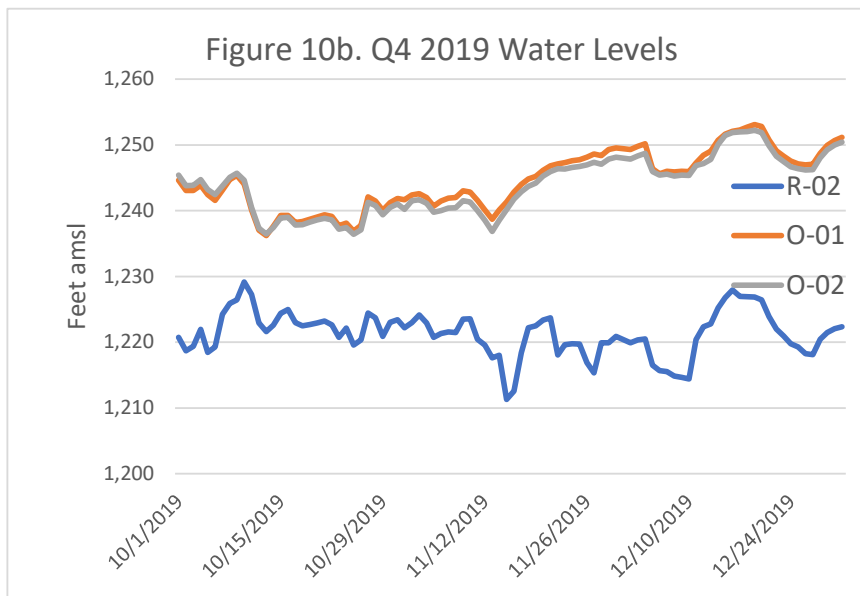
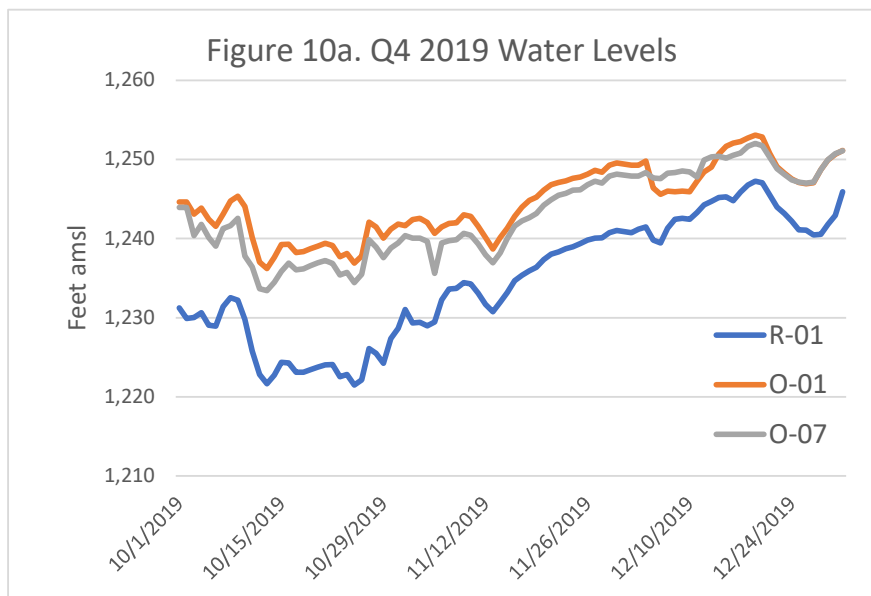
JANUARY 2020

FIGURE 8

Figure 9. Injection and Recovery Volumes, Q4 2019.

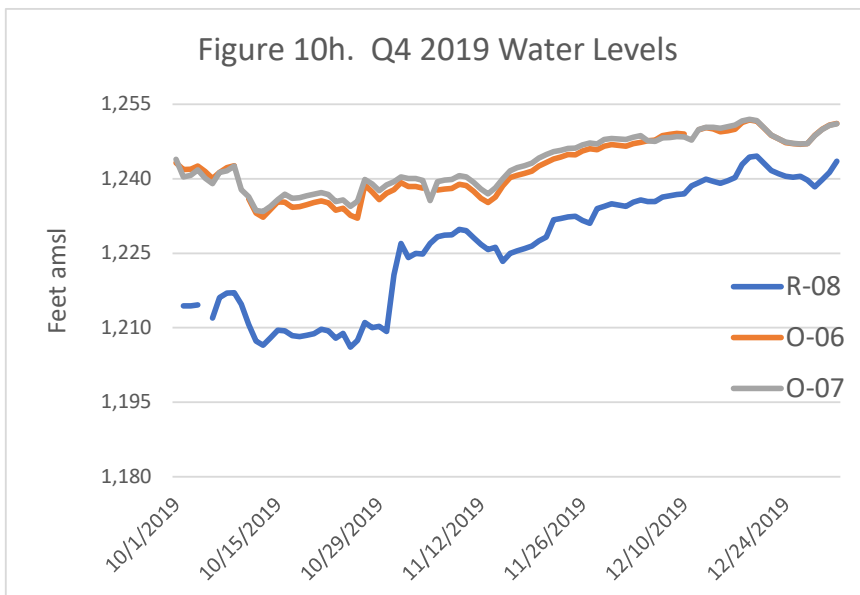
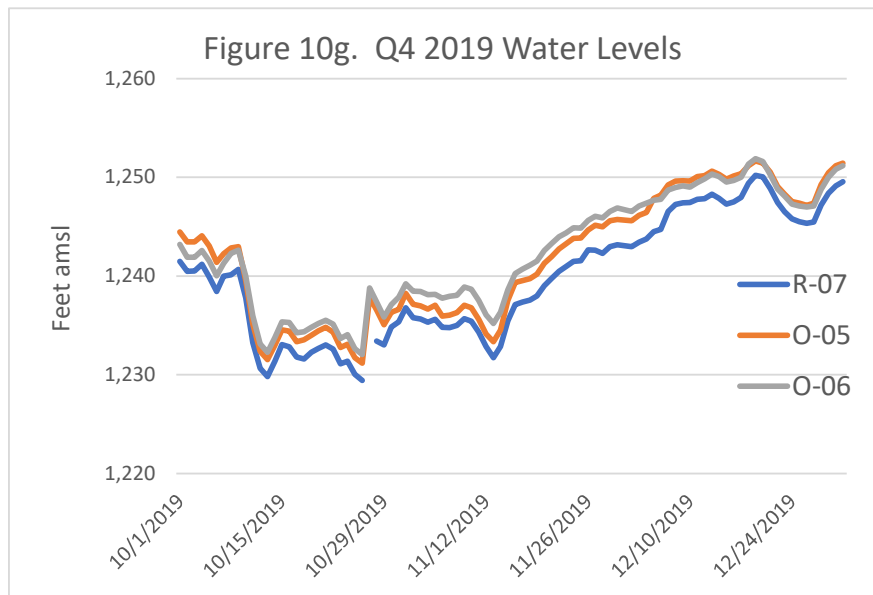
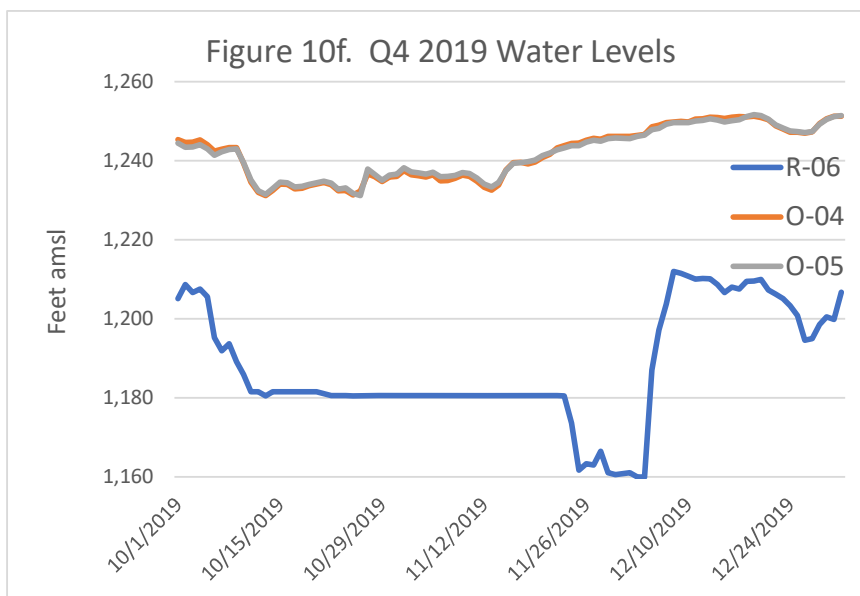
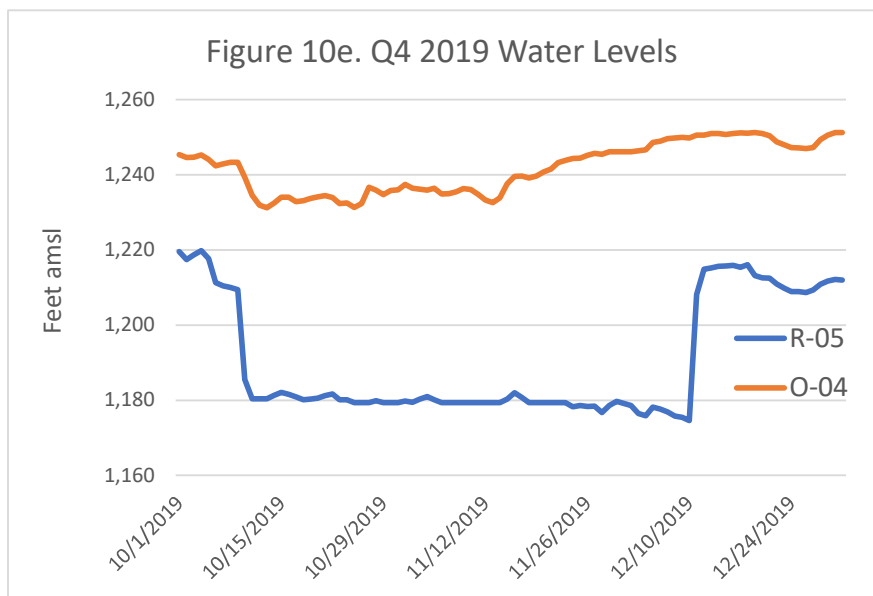


Figures 10a - 10h. Hydraulic Gradient - Daily Average Water Level Elevations - Observation and Recovery Wells





Figures 10a - 10h. Hydraulic Gradient - Daily Average Water Level Elevations - Observation and Recovery Wells



## **ATTACHMENT 1**

### **Technical Memorandum, Summary of the Cause for Exceedance of the Bulk Electrical Conductivity Alert Level at the PTF Wellfield**

**TECHNICAL MEMORANDUM**

10 January 2020  
File No. 129687-012

**TO:** Florence Copper Inc.  
Richard Tremblay, Vice President Operations

**FROM:** Haley & Aldrich, Inc.  
Mark Nicholls, R.G.

**SUBJECT:** Summary of the Cause for Exceedance of the Bulk Electrical Conductivity Alert Level at the PTF Wellfield

**Introduction**

Florence Copper Inc. (Florence Copper) operates the Production Test Facility (PTF) wellfield for the purpose of demonstrating the feasibility of In-Situ Copper Recovery (ISCR) methods to recover copper from the Poston Butte copper deposit in Florence, Arizona. The PTF is authorized by Temporary Aquifer Protection Permit (APP) No. P-106360 and Underground Injection Control (UIC) Permit No. R9UIC-AZ3-FY11-1. Section 2.2.4 of the APP requires that Florence Copper measure bulk electrical conductivity (bulk EC) to confirm hydraulic control. Section 2.5.9 of the APP sets forth the requirements for establishing ambient bulk EC values, and for calculating an appropriate bulk EC alert level (AL). Section 2.6.2.7 of the APP sets forth requirements associated with a confirmed exceedance of the bulk EC AL.

This Technical Memorandum describes confirmed exceedances of the bulk EC AL on three monitoring horizons at three PTF observation wells beginning on 21 November 2019. In accordance with Section 2.6.2.7(4) of the APP, this Technical Memorandum describes the cause, impact, mitigation of the exceedances, and describes any errors in measurement, data analysis, and statistical evaluation of the bulk EC data.

**Bulk EC Monitoring Description**

In accordance with requirements of the APP, Florence Copper has been collecting bulk EC data weekly, and comparing those data to the ALs established based on ambient bulk EC monitoring conducted prior to the start of PTF operations. The bulk EC compliance monitoring system includes three bulk EC sensors, installed on each of the seven observation wells (identified as O-01 through O-07) at the edge of the PTF wellfield, resulting in a total of 28 sensors. The location of the observation wells relative to the PTF wellfield is shown on Figure 1. The sensors are configured to create four horizontal monitoring



horizons with a vertical separation of 20 feet between each horizon. The monitoring horizons are numbered 1 through 4, with horizon 1 being the highest in elevation and horizon 4 being the lowest. Horizon 4 is located in the middle of the 40-foot thick exclusion zone and is not used for compliance monitoring, but is used for operational monitoring to allow Florence Copper to adjust operations prior to an excursion reaching the compliance bulk EC sensors placed 20 feet above at the contact between bedrock and the lower basin fill unit (LBFU). Bulk EC monitoring horizon 3 is at the bedrock LBFU contact, monitoring horizon 2 is 20 feet above the contact within the LBFU, and monitoring horizon 1 is 40 feet above the contact also within the LBFU.

Monitoring is conducted by serially energizing each of the individual sensors on each monitoring horizon and recording the relative signal at each of the other sensors on that monitoring horizon. The resulting measurement reflects the combined conductivity of all material and fluid between the energized sensor and the receiving sensor. The sending and receiving sensors are referred to as “sensor pairs” throughout the remainder of this document. The value measured between each sensor pair is referred to as “bulk conductivity” because it reflects the combined relative conductivity of the formation material, groundwater, well casings, annular materials, and injected fluid (if present) between the sensors. Bulk EC values are reported in terms of resistivity, which is the inverse of conductivity, and the reporting units are ohm-meters ( $\Omega\cdot m$ ).

The bulk EC AL values are a lower limit, consequently a bulk EC value that declines below the AL is characterized as an exceedance. Because the injected fluid has significantly higher conductivity than native groundwater, a vertical excursion of injected fluid will result in a localized increase in bulk EC detected at multiple sensor pairs. Florence Copper submitted a proposal in August 2018, that included a description of the method for establishing the bulk EC ALs and included discussion of method sensitivity and factors that may affect bulk EC values.

Based on the configuration of the bulk EC monitoring system, a hypothetical vertical excursion of injected fluid would progress upward from a localized detection of decreased resistivity at the lowest monitoring horizons. Because the ISCR fluid is very conductive, an excursion of fluid from the injection zone would abruptly change the measured bulk EC value in a very short time frame, in contrast to the gradual changes that would be expected from environmental changes or sensor drift. The localized occurrences would expand horizontally on the lower horizons as new detections occurred on the upper horizons. A vertical excursion would thus be detected first on monitoring horizon 4, then on monitoring horizons 3, 2, and 1, in that order. A vertical excursion of injected fluid would be accompanied by the following sequential observations:

1. Localized detection of reduced resistivity at a localized area on monitoring horizon 4.
2. Localized detection of reduced resistivity at a localized area on monitoring horizon 3 and expanding localized detection of reduced resistivity on horizon 4.
3. Localized detection of reduced resistivity at a localized area on monitoring horizon 2 and expanding localized detection of reduced resistivity on horizons 3 and 4.
4. Localized detection of reduced resistivity at a localized area on monitoring horizon 1 and expanding localized detection of reduced resistivity on horizons 2, 3, and 4.

Bulk EC monitoring is an effective means to monitor for vertical migration of injected fluid above the exclusion zone but relies on the assumption that migration of injected fluid is the only changing condition within the wellfield, and that all other factors affecting bulk EC remain unchanged during PTF operations. Consequently, changes in other conditions at the PTF wellfield that affect bulk EC have the potential to depress the resistivity values resulting in an apparent bulk EC exceedance.

## Confirmed Bulk EC Exceedance

Bulk EC data collected on 21 November 2019, reflected a downward shift in resistivity values measured between all sensor pairs on all monitoring horizons. The downward shift in resistivity values resulted in exceedance of the AL at five sensor pairs located on three monitoring horizons. The exceedances were first observed in bulk EC data collected on 21 November 2019, which were reported to Florence Copper on 2 December 2019, following completion of statistical analysis of the raw data. The exceedances were confirmed by bulk EC measurements made on 26 November and 3, 4, and 5 December 2019.

Statistical analysis of the bulk electrical conductivity data collected through 5 December were completed on 10 December 2019. Florence Copper was notified that the exceedances were confirmed on 11 December 2019. The observed changes in bulk EC values measured on 21 November reflect a relative change in bulk EC of between 1 and 8 percent relative to previous measurements. The electrode pairs that indicated exceedance of the bulk EC ALs experienced changes of 2 to 3 percent and exhibited the lowest baseline bulk EC values. The observed exceedances and confirmation measurements are summarized in Table 1.

**Table 1. Summary of Observed Bulk EC Exceedances and Confirmation Values**

Horizon and Electrode Pair*	AL ( $\Omega$ -m)	11/21 Results ( $\Omega$ -m)	11/26 Results ( $\Omega$ -m)	12/3 Results ( $\Omega$ -m)	12/4 Results ( $\Omega$ -m)	12/5 Results ( $\Omega$ -m)	12/11 Results ( $\Omega$ -m)
Horizon 1, between wells O-05 and O-06	9.93	9.77	9.77	9.72	9.72	9.71	9.77
Horizon 1, between wells O-06 and O-07	9.93	9.85	9.84	9.82	9.79	9.81	9.85
Horizon 2, between wells O-05 to O-06	10.12	10.00	9.99	9.96	9.94	9.94	9.99
Horizon 3, between wells O-05 to O-06	10.33	10.28	10.28	10.23	10.22	10.21	10.26
Horizon 3, between wells O-05 to O-07	10.33	10.20	10.20	10.13	10.13	10.10	10.18
*Horizon 3 is the deepest compliance monitoring horizon and is located at the bedrock lower basin fill unit contact and is the closest to the injection zone. Horizon 1 is the shallowest monitoring horizon and is furthest from the injection zone.							

Once the potential exceedances were confirmed, Haley & Aldrich, Inc. (Haley & Aldrich) conducted an evaluation of the wellfield conditions, operations, meteorological changes, and other environmental changes to identify the cause of the exceedances in accordance with Section 2.6.2.7 of APP No. P-106360.

## Comparative Bulk EC Values from PTF Operational Monitoring

In addition to the compliance bulk EC monitoring conducted at horizons 1 through 3, Florence Copper is conducting operational bulk EC monitoring at horizon 4 and at greater depth within the injection zone. The operational monitoring provides for comparison of the measured bulk EC values measured for compliance monitoring with values measured in areas where injected solution is known to be in contact with bedrock, and at locations between the injection zone and the compliance monitoring points.

### OPERATIONAL MONITORING AT HORIZON 4

As described above, APP No. P-106360 establishes bulk EC AL values for monitoring horizons 1 through 3. Horizon 4 is located 20 feet below horizon 3 in the middle of the 40-foot thick exclusion zone and does not have an AL. Monitoring horizon 4 is used for operational monitoring to allow Florence Copper to identify changing conditions prior to a potential vertical excursion reaching the LBFU. The monitoring system is configured such that a vertical excursion would have to pass horizon 4 before reaching the other horizons. Consequently, horizon 4 would thus be expected to have a lower resistivity value than that observed on the higher horizons in the event of a vertical excursion.

Bulk EC data collected at monitoring horizon 4, at the time the exceedances were identified and confirmed on horizons 3, 2, and 1, showed higher resistivity values than the overlying horizons and a similar magnitude of change. This fact indicates that there is no notable differential between the changes observed on horizon 4, relative to the changes observed on horizons 3, 2, and 1, and that there is no residual evidence of upward migration of injected fluid. Table 2 lists the bulk EC values measured on horizon 4 at observation wells O-05, O-06, and O-07 during the monitoring events which detected and confirmed the AL exceedances on horizons 1, 2, and 3.

**Table 2. Summary of Observed Bulk EC Values on Horizon 4 During the Period Exceedances Were Observed and Confirmed on Horizons 3, 2, and 1**

Horizon and Electrode Pair*	AL ( $\Omega$ -m)	11/21 Results ( $\Omega$ -m)	11/26 Results ( $\Omega$ -m)	12/3 Results ( $\Omega$ -m)	12/4 Results ( $\Omega$ -m)	12/5 Results ( $\Omega$ -m)	12/11 Results ( $\Omega$ -m)
Horizon 4, between wells O-05 and O-06	N/A	10.62	10.61	10.57	10.56	10.53	10.60
Horizon 4, between wells O-05 and O-07	N/A	10.47	10.47	10.40	10.39	10.38	10.46
*Horizon 3 is the deepest compliance monitoring horizon and is located at the bedrock lower basin fill unit contact. Horizon 4 is located within the exclusion zone, is monitored for operational purposes, and does not have an alert level.							

### OPERATIONAL MONITORING IN THE INJECTION ZONE

In addition to the bulk EC monitoring system constructed for the purpose of compliance and operational monitoring described above, Florence Copper has constructed an additional bulk EC operational monitoring system within the injection zone to facilitate analysis of fluid flow between the injection and



recovery wells. Operational monitoring within the injection zone began prior to the commencement of injection and has continued throughout 2019. This operational monitoring within the injection zone provides an opportunity to compare bulk EC values, where injected solution is known to be in contact with bedrock, to the observed bulk EC values in the overlying monitoring horizons 1 through 4. The uppermost operational bulk EC monitoring within the injection zone is conducted at a depth of 168 feet below monitoring horizon 4.

Operational monitoring within the injection zone yields bulk EC values that are consistently below 3  $\Omega$ -m throughout the injection zone, and are in the range of 2  $\Omega$ -m at a depth of 168 feet below monitoring horizon 4. If a vertical excursion were moving upward from the injection zone through monitoring horizon 4, it is anticipated that bulk EC measurements at horizon 4 would reflect the low bulk EC values observed in the injection zone. However, the bulk EC values measured at horizon 4 remain some of the highest observed in the monitoring network, indicating that a vertical excursion has not occurred.

## **Bulk EC AL Exceedance Cause, Impact, and Mitigation**

### **OBSERVED BULK EC SENSITIVITY TO PRECIPITATION DURING THE AMBIENT MONITORING PERIOD**

Bulk EC monitoring is a highly sensitive method used for detecting changes in the conductivity of the formation materials above the PTF injection zone. As described in the August 2018 AL proposal, this method of monitoring is sensitive to environmental changes in addition to those generated by migration of injected fluid. The AL proposal described potential spatial variability related to lithology, moisture content, fluid temperature, and electrolyte content, and temporal variability related to seasonal changes, meteorological events, and sensor drift.

Baseline bulk EC data was collected at the PTF wellfield between 24 May and 3 August 2018. The baseline bulk EC data showed sensitivity to precipitation events, but relatively low variability (generally less than 1  $\Omega$ -m). The variability of the baseline dataset, sensitivity to environmental changes, and method for calculation of the ALs are described in the August 2018 AL proposal.

Section 4.1.2 of the August 2018 AL proposal describes the effects on the baseline dataset of precipitation events occurring on 16 through 17 June and 29 through 31 July 2018. Both of these events precede notable declines in the bulk EC values compared to values measured before the precipitation events. The 16 through 17 June 2018 precipitation event produced approximately 1 inch of rain and preceded a decline in bulk EC values of up to 0.77  $\Omega$ -m and 5.1 percent compared to pre-event values. The 29 through 31 July 2018 precipitation event produced approximately 0.7 inch of rain and preceded a decline in bulk EC values of up to 1.3  $\Omega$ -m and 4.9 percent compared to pre-event values.

The August 2018 AL proposal noted that rainfall added soil moisture at the surface which would lower temperatures in the surficial infrastructure used to collect the data. Temperature fluctuations change the resistivity of the cables used to transmit the signals to and from the wells from the resistivity instrument as well as the cables at the surface used as reference electrodes. It is also important to note that the ambient bulk EC data were collected over a relatively short period of time in the summer of 2018, and consequently do not fully characterize potential seasonal variability arising from reduced

ambient air temperatures and reduced evaporation of residual soil moisture. These types of seasonal changes have the potential to affect the surficial components of the bulk EC monitoring system, the grounding network, and the reference electrodes used to process the raw bulk EC data. The ambient bulk EC data, observed temporal variability during the ambient monitoring period, and correlation to precipitation events are described in the August 2018 AL proposal.

### **CORRELATION OF OBSERVED CHANGES IN BULK EC AND PRECIPITATION EVENTS**

Comparison of bulk EC data, collected during the operational monitoring period, to precipitation data show correlation between precipitation events and observed declines in bulk EC values. Figures 2 through 8 are time series plots of the average measured bulk EC values at each of the four monitoring horizons at each of the seven observation wells throughout the operational monitoring period beginning on 21 September 2018 and extending through 23 December 2019. The bulk EC data are plotted together with precipitation data from a weather station (NOAA Station ID US1AZPN0075) located approximately 3.3 miles northeast of the PTF wellfield.

Figures 2 through 8 show that decline in bulk EC values occurred on all four monitoring horizons following significant rain events throughout 2019, and that successive smaller rain events have a cumulative residual effect on bulk EC values. During dry periods between rain events, as residual soil moisture evaporates and soil temperatures rise, bulk EC values appear to stabilize or trend upwards. Figures 2 through 8 also show the following notable characteristics:

1. A downward shift of bulk EC values has occurred at a similar magnitude on every monitoring horizon (horizons 1 through 4) following significant precipitation events and successive smaller precipitation events. Review of the underlying data show that a similar magnitude downward shift occurs on every sensor pair in the monitoring system on every monitoring horizon. This type of shift indicates that changing conditions affected the entire monitoring system equally, and that the change is not related to upward migration of injected fluid, but rather with a change in the baseline conditions in the grounding network or reference electrodes used to process the individual bulk EC measurements.
2. The downward shift in bulk EC values detected on 21 November 2019 was preceded by two precipitation events (14 and 20 November 2019) that each produced greater than 1 inch of precipitation. Similar declines in bulk EC values were preceded by precipitation events on 25 September 2019, cumulative precipitation events between 31 January through 14 February 2019, and cumulative precipitation events between 5 and 19 October 2018. Similar to the 21 November precipitation event, each of the earlier precipitation events preceded system wide decline in bulk EC values.
3. The observed changes in bulk EC values are not spatially localized within the PTF wellfield, suggesting that there is not a localized pathway for vertical migration of solution.
4. The observed change in bulk EC values did not progress from the lowest level sensors on monitoring horizon 4, upward to horizons 3, 2, and 1 as would be expected if a vertical excursion of injected fluid had occurred. Rather, the change occurred at a similar magnitude, at the same time, at all sensor pairs on all monitoring horizons.

5. The resistivity values measured at monitoring horizon 4 remain higher than those measured in horizons 3, 2, and 1. This indicates that injected solution has not migrated upward through horizon 4 to reach horizons 3, 2, and 1. Had injected solution migrated vertically upward, it is anticipated that the lowest monitoring horizon, horizon 4, would have a lower resistivity than the overlying horizons instead of the higher values measured at horizon 4.
6. Additional rain events occurred following the initial exceedance detection on 21 November and during the period when confirmation monitoring was conducted.

It is important to note that precipitation falling on the surface at the PTF wellfield is not infiltrating to the bulk EC sensors located in the well bores to cause a decrease in bulk EC values. Rather, precipitation falling on the surface is affecting the equipment, grounding network, and reference electrode system located at ground surface which are used to collect the bulk EC data for processing the raw data.

Based on the data and information presented above, the bulk EC exceedances detected on 21 November 2019, and confirmed 26 November through 5 December 2019, were caused by the residual effects of successive precipitation events occurring prior to 21 November, which increased cumulative ambient soil moisture, decreased soil temperature, and resulted in other environmental changes affecting the surficial components of the bulk EC monitoring network, associated grounding network, and reference electrodes. These environmental changes had a systemwide affect, reducing all measured bulk EC values at all electrode pairs on all monitoring horizons by a similar magnitude, and resulted in the electrode pairs with the lowest ambient bulk EC values exceeding the horizon AL values.

## **Environmental Impacts**

The observed bulk EC exceedances described above are the result of ambient environmental changes at ground surface and are not the result of a vertical excursion of injected fluid. No adverse environmental impacts are known to have occurred as a result of the observed bulk EC exceedances.

## **Mitigation of Environmental Impacts**

No adverse environmental impacts are known to have occurred as a result of the observed bulk EC exceedances. Consequently, no mitigation of environmental impacts is required.

In accordance with Section 2.6.2.7 of the APP Permit, Florence Copper has increased the bulk EC monitoring frequency to three times per week. Florence Copper continues to actively monitor wellfield operational conditions and to actively maintain hydraulic control.

The August 2018 AL proposal included discussion of potential change in ambient bulk EC conditions arising from seasonal changes, instrument drift and other factors, and identified the potential need to revise the bulk EC ALs based on these factors. Haley & Aldrich has commenced statistical analysis of the bulk EC data for the purpose of re-calculating AL values to be included in a proposal for revised AL values in an application to amend APP No. P-106360.



## **Potential Errors in Measurement, Data Analysis, and Statistical Evaluation**

Haley & Aldrich has reviewed measurement, data analysis, and statistical analyses of the bulk EC data and has concluded that the observed bulk EC exceedances did not result from errors in measurement, data analysis, or statistical analysis.

## **Conclusion**

The bulk EC exceedances detected on 21 November 2019, and confirmed 26 November through 5 December 2019, are the result of natural changes in ambient environmental conditions at the PTF wellfield. The ambient environmental changes which resulted in the bulk EC exceedances were referenced in the August 2018 AL proposal describing the ambient bulk EC dataset, ambient data variability, and proposed method for AL calculation. The AL proposal specifically identified the sensitivity of the bulk EC monitoring method to precipitation events and provided direct examples of precipitation events that resulted in similar changes to ambient bulk EC values.

The confirmed bulk EC exceedances were caused by the cumulative effects of precipitation events occurring prior to 21 November 2019 which resulted in an increase of ambient soil moisture, decreased soil temperature, and resulted in other environmental changes affecting the surficial components of the bulk EC monitoring network, associated grounding network, and reference electrodes.

The exceedances are not the result of measurement error, data analysis error, or error in statistical analyses. The confirmed bulk EC exceedances are not the result of vertical excursion of injected fluid, no impacts to the environment are known to exist as a result of the bulk EC exceedances, and no environmental mitigation is required.

Haley & Aldrich has commenced statistical analysis of the bulk EC data for the purpose of re-calculating AL values and Florence Copper will propose revised AL values in an application to amend APP No. P-106360.

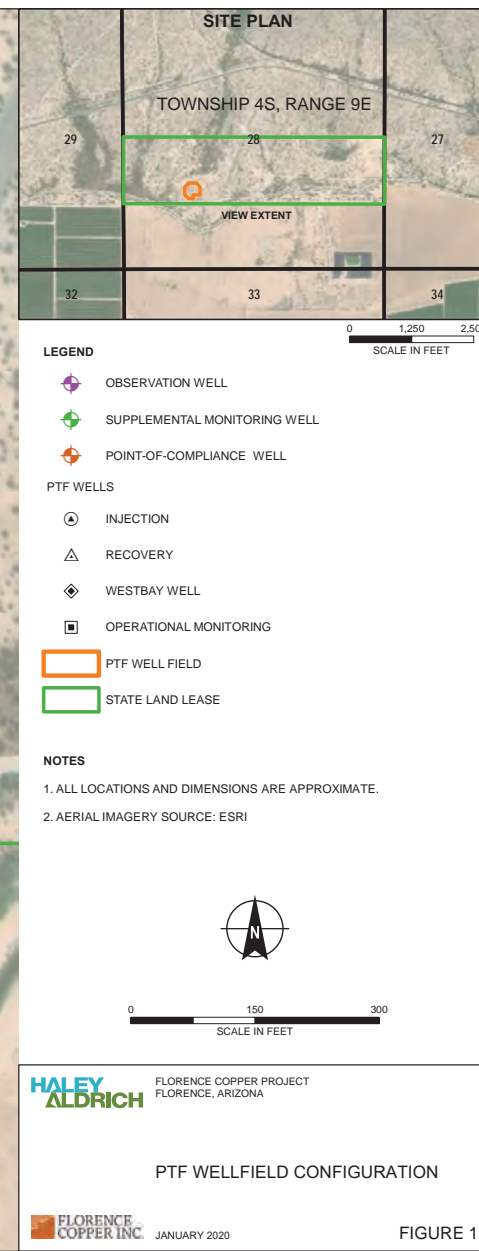
Please contact Mark Nicholls with any questions you may have regarding the content of this Technical Memorandum.

### **Enclosures:**

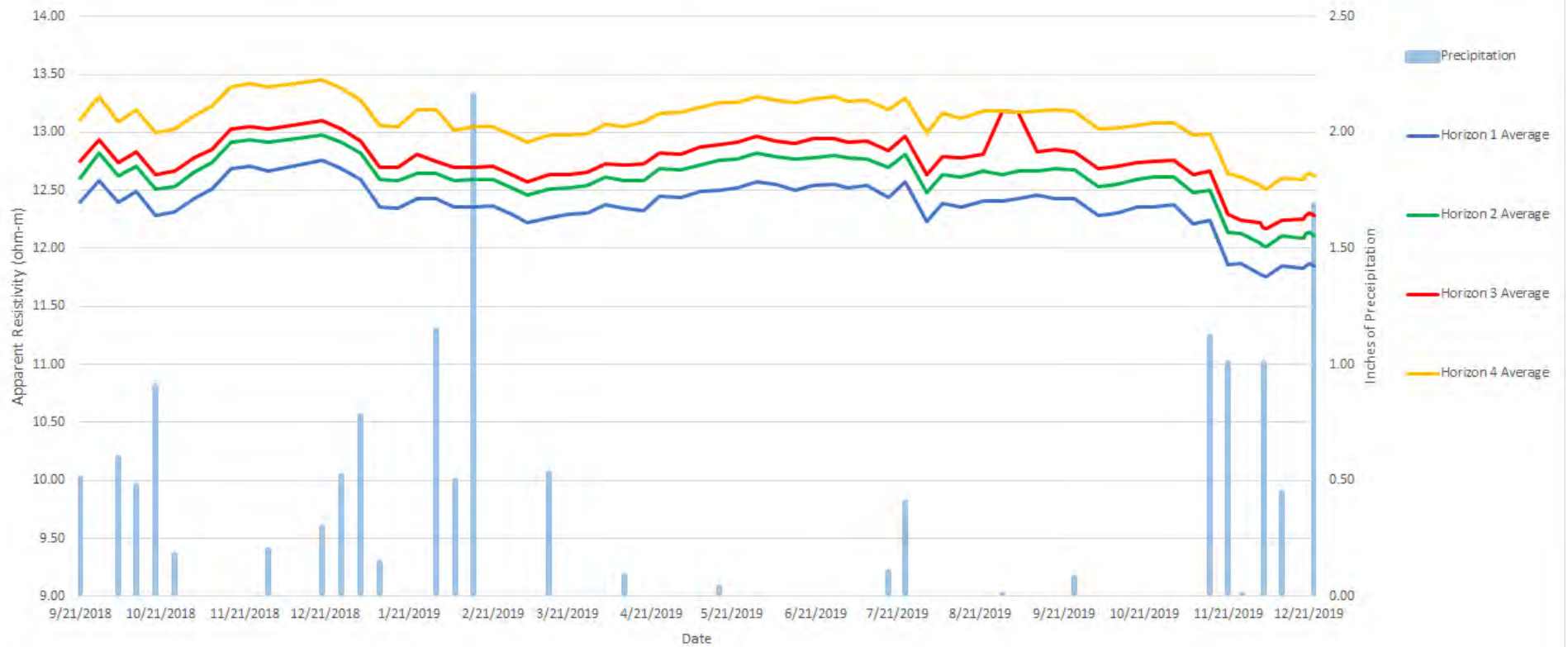
- Figure 1 – PTF Wellfield Configuration
- Figure 2 – Observation Well O-01: All Horizons
- Figure 3 – Observation Well O-02: All Horizons
- Figure 4 – Observation Well O-03: All Horizons
- Figure 5 – Observation Well O-04: All Horizons
- Figure 6 – Observation Well O-05: All Horizons
- Figure 7 – Observation Well O-06: All Horizons
- Figure 8 – Observation Well O-07: All Horizons

## FIGURES

G:\S FILE PATH\G:\Projects\Florence Copper\120607 PTF Well Drilling\GIS\Maps\2018\_06\120607 PTF Well Locations.mxd — USER: DFM — LAST SAVED: 7/25/2018 4:09:40 PM



# Well O-01: All Horizons



HALEY  
ALDRICH

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

(REVISED 16 JANUARY 2020)

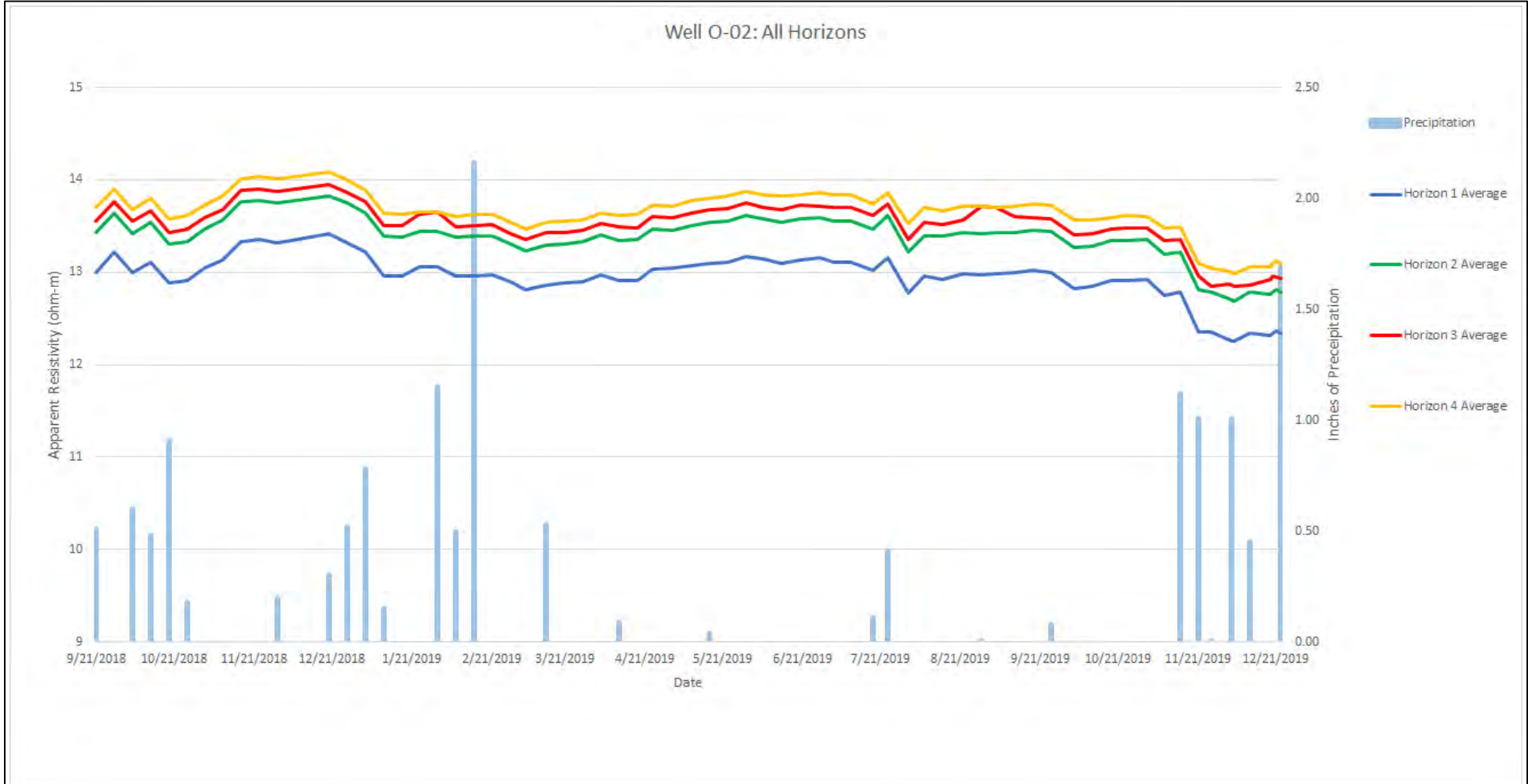
OBSERVATION WELL O-01:  
ALL HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 2





HALEY  
ALDRICH

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

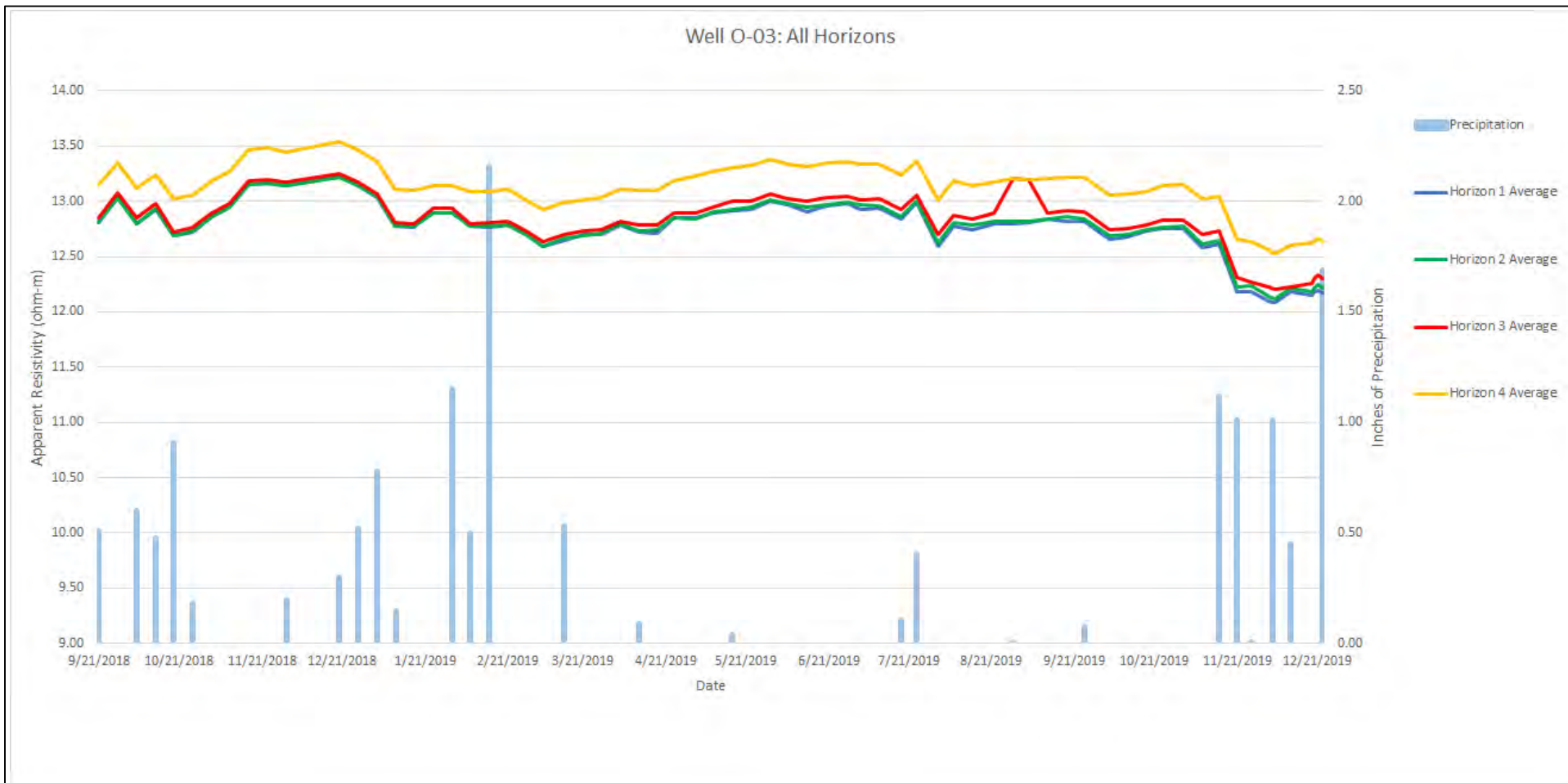
(REVISED 16 JANUARY 2020)

OBSERVATION WELL O-02:  
ALL HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 3



**HALEY  
ALDRICH**

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

(REVISED 16 JANUARY 2020)

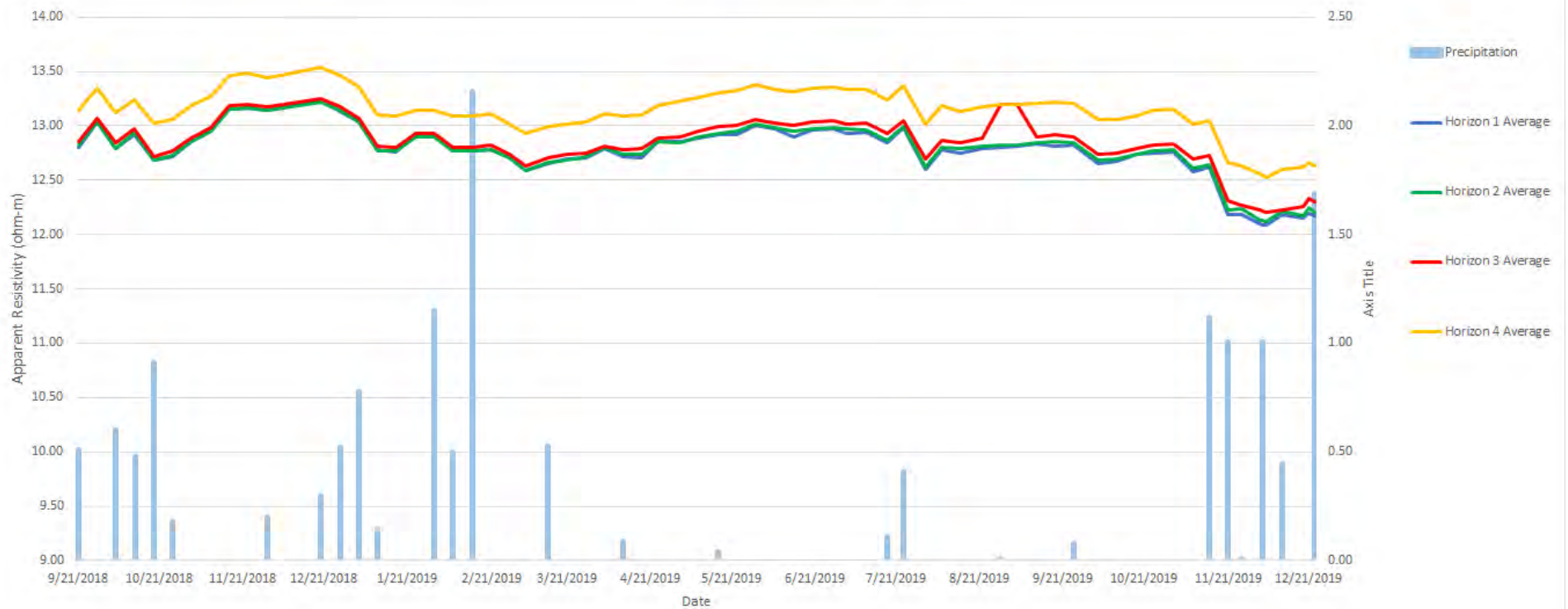
OBSERVATION WELL O-03:  
ALL HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 4

Well O-04: All Horizons



HALEY  
ALDRICH

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

(REVISED 16 JANUARY 2020)

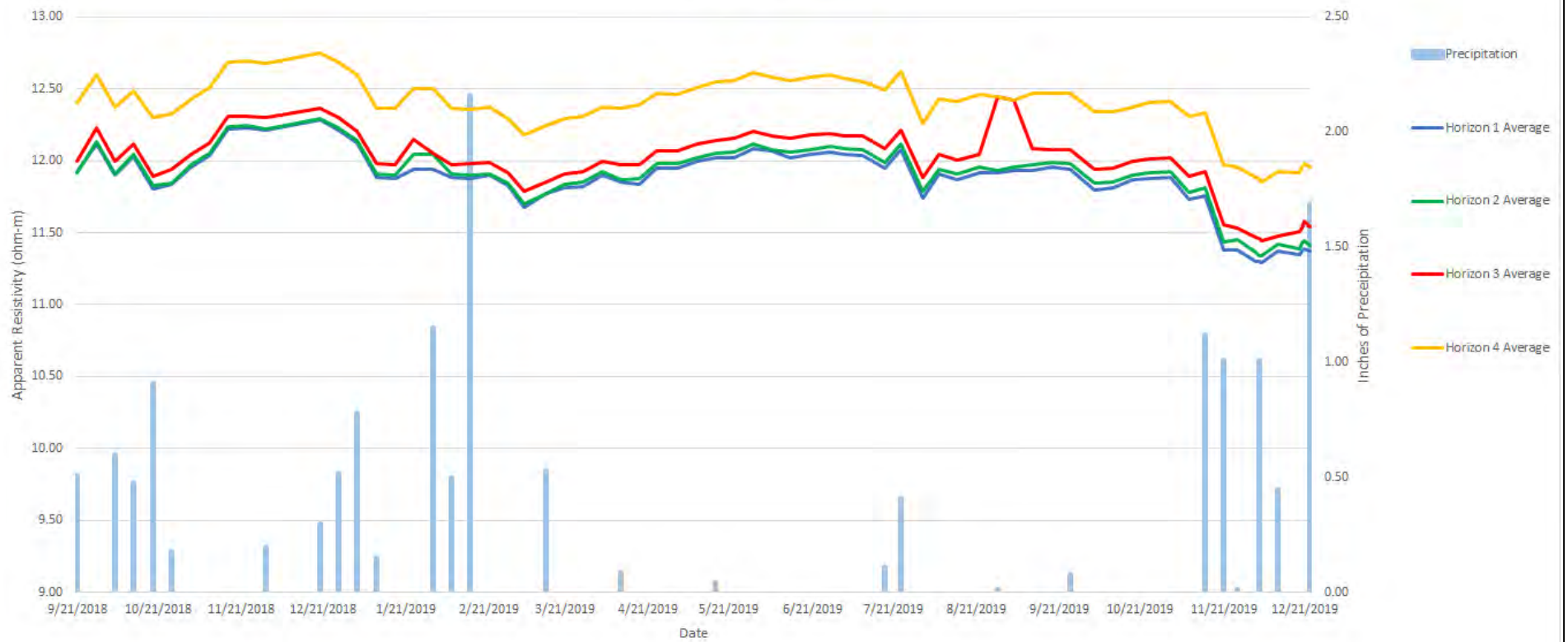
OBSERVATION WELL O-04:  
ALL HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 5

Well O-05: All Horizons



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PTF WELLFIELD  
FLORENCE, ARIZONA

(REVISED 16 JANUARY 2020)

OBSERVATION WELL O-05:  
ALL HORIZONS

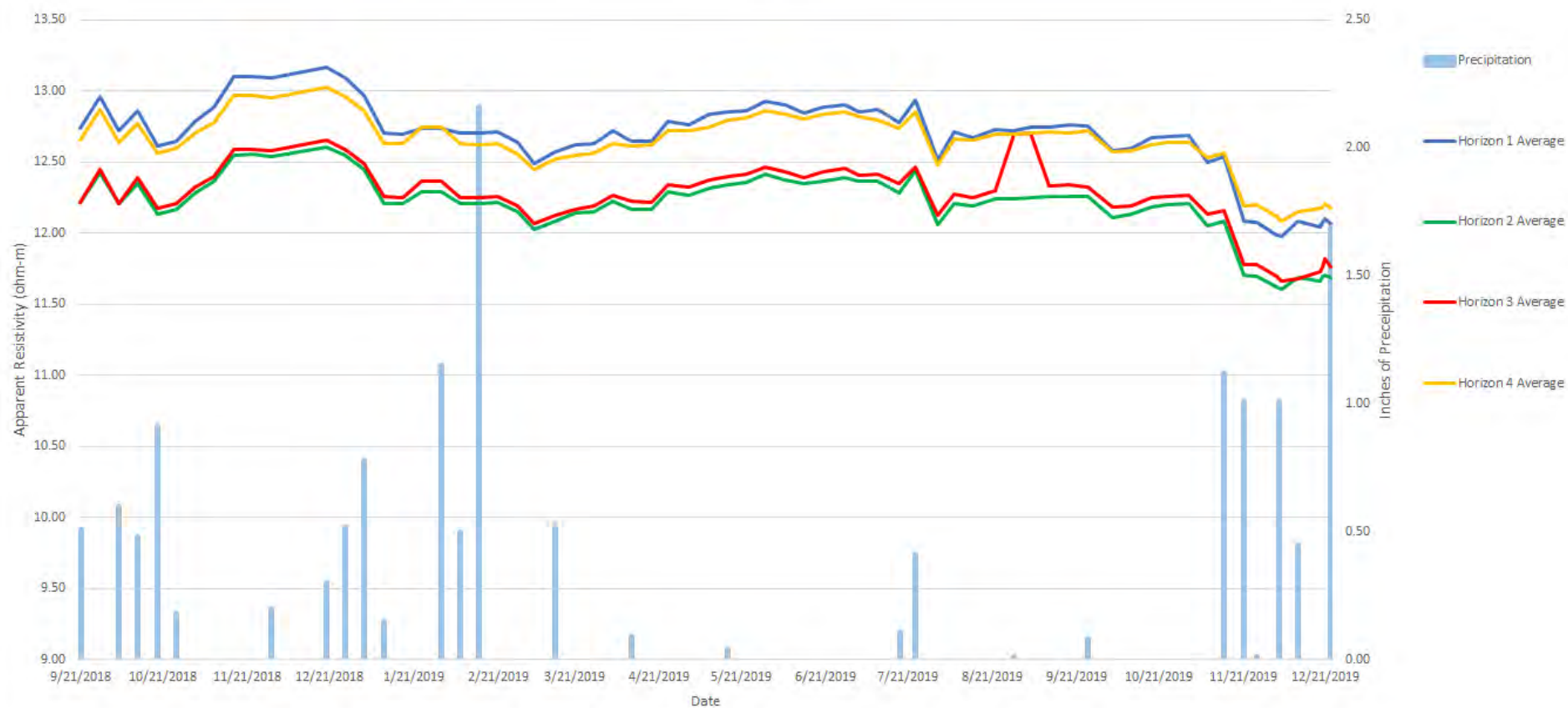
FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 6



Well O-06: All Horizons



HALEY  
ALDRICH

FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

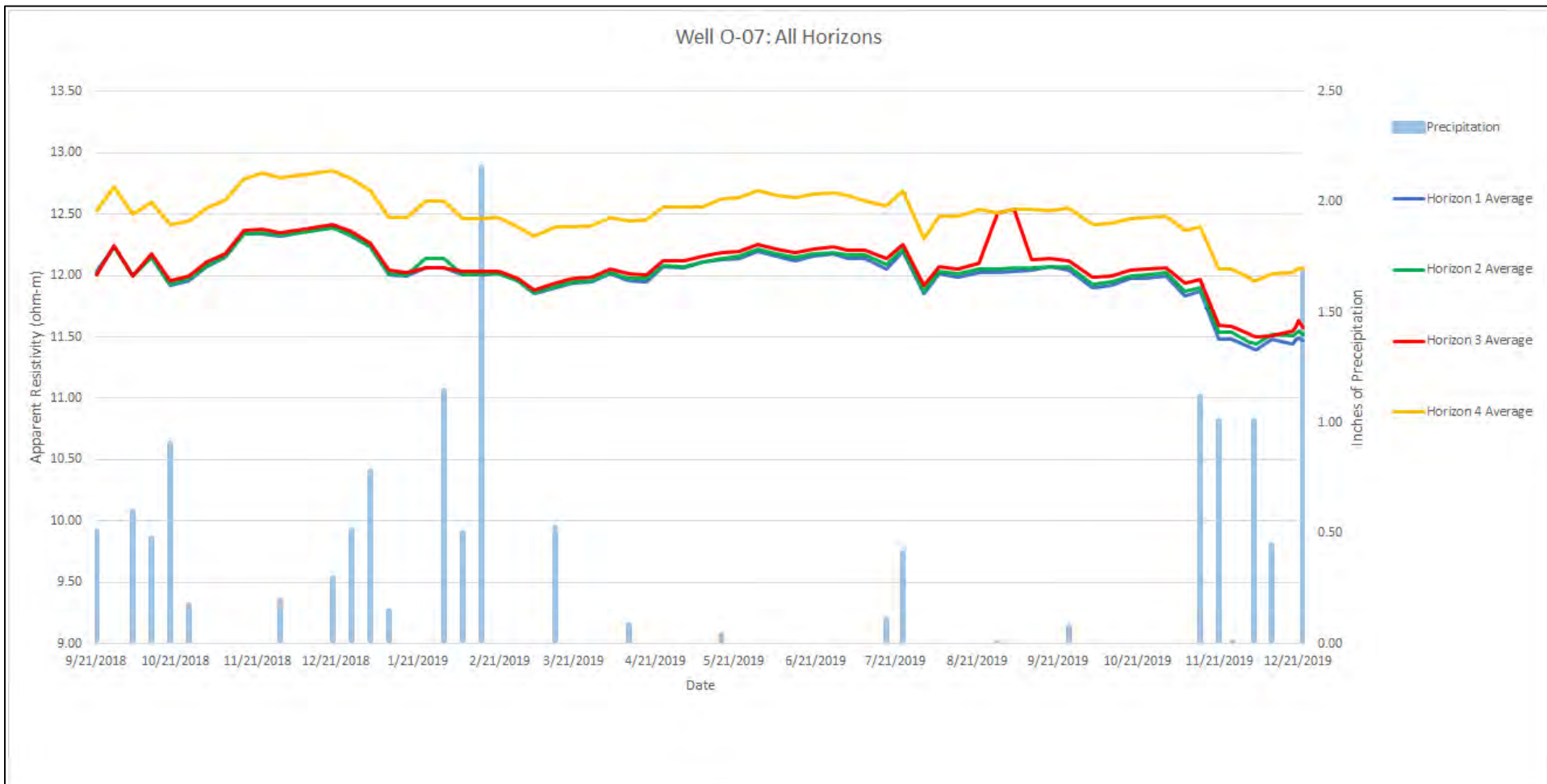
(REVISED 16 JANUARY 2020)

OBSERVATION WELL O-06:  
ALL HORIZONS

FLORENCE  
COPPER INC.

JANUARY 2020

FIGURE 7



FLORENCE COPPER INC.  
PTF WELLFIELD  
FLORENCE, ARIZONA

(REVISED 16 JANUARY 2020)

OBSERVATION WELL O-07:  
ALL HORIZONS



JANUARY 2020

FIGURE 8

**ATTACHMENT 2**

**HGI Conductivity Data QA Procedure and Documentation Form**



# BULK CONDUCTIVITY DATA QA PROCEDURE & DOCUMENTATION FORM (V.2)

## GENERAL

<b>Project Name:</b> 2018-030 Bulk Conductivity Monitoring	<b>Project Site:</b> Florence Copper Inc	<b>Date:</b>
<b>Weather Conditions and Ambient Temp:</b>	<b>Field Operator Name:</b>	<b>Start and End Time:</b>

## EQUIPMENT (See back of for detailed instructions and procedures)

<b>SuperSting (SS) Serial #:</b>	<b>Program Switchbox Addresses</b> Pass Criteria: Instrument pass Circle One: <b>Pass or Fail</b>	<b>Program Cable Addresses</b> <table><tr><td>Section</td><td><u>AddrL</u></td><td>to</td><td><u>AddrH</u></td></tr><tr><td>1</td><td>1</td><td></td><td>28</td></tr></table>	Section	<u>AddrL</u>	to	<u>AddrH</u>	1	1		28
Section	<u>AddrL</u>	to	<u>AddrH</u>							
1	1		28							
<b>Switch Box (SB) Serial #:</b>										

## DIAGNOSTIC TESTING (See back of for detailed instructions and procedures)

<b>Relay Test</b> Pass Criteria: Instrument pass Circle One: <b>Pass or Fail</b>	<b>Receiver Test</b> Pass Criteria: All Channel = 500mΩ (±25) Circle One: <b>Pass or Fail</b>	<b>Contact Resistance Test</b> Pass Criteria: All values less between 50-200 Ω Circle One: <b>Pass or Fail</b>
--	---	--

## DATA COLLECTION SETUP (See back of for detailed instructions and procedures)

<b>Forward Set Data File Name:</b>	<b>Reverse Set Data File Name:</b>	<b>Measurement Settings:</b>
<b>Command File Name:</b> <b>Forward</b>	<b>Command File Name:</b> <b>Reverse</b>	1. No. Cycles: <b>4</b>
<b>Array:</b> <b>Pole-Pole</b>	<b>Array:</b> <b>Pole-Pole</b>	2. Max Error: <b>Off</b>
<b>Reference Electrode Names</b> B (TX): Red Wire (P8-2-0) N (RX): Blue Wire (M26-0)	<b>Reference Electrode Names</b> B (TX): Blue Wire (M26-0) N (RX): Red Wire (P8-2-0)	3. Max Repeat: <b>Off</b>
		4. Max Current: <b>2000mA</b>
		5. Measure Time: <b>3.6</b>
		6. Separate potential : <b>OFF</b>
		7. Measure mode: <b>RES</b>
		8. Defaults: <b>USER</b>
		9. Use address Table:

## DATA QUALITY ACCEPTANCE (See back of sheet for detailed instructions and procedures)

<b>Reciprocal Data Evaluation</b> Pass Criteria: 70% of reciprocal difference values less than 10% Circle One: <b>Pass or Fail</b>	<b>Measurement Error Evaluation</b> Pass Criteria: 70% of measurement error values less than 5% Circle One: <b>Pass or Fail</b>
--	---

## COMMENTS (Briefly Describe Florence Copper Activities at time of data acquisition)

--	--

## SIGNATURE

<i>By signing, I certify that data collection instrumentation pass all required tests and the data collection process followed all required setup and programming instructions listed within this procedure.</i>	<i>By signing, I certify that measured data pass all required data quality tests listed within this procedure.</i>
<hr/>	<hr/>
<b>Field Operator Signature/Date</b>	<b>Data Inspector Signature/Date</b>



### **1) Program Switchbox Address Procedure**

Connect Switch Box without electrodes or remotes connected

SS Main Menu >> 3. Test Mode >> 5. Program Address >>

1. Set address :1

2. Set Serial Board Number : 1

F3 to set by serial number>> Period to continue>> Should give you a pass reading.

### **2) Program Cable Address Procedure**

This will be done during file setup. If there is an issue with setup go to

SS Main Menu >> 6. System Settings >> 2. Cable Address Set up >>

1. Enter Addresses

2. Clear Table

Press 1 to enter the lowest address of the cable (1). Hit enter. Enter the highest address of the cable (28). Hit Enter.

### **3) Relay Test Procedure**

Connect the SB to the SS (or if internal SB, have nothing connected to the SS). During the test, the A and B relays are tested for each electrode switch. A good switch will cycle through the following display on each electrode number (Electrode: #, Connection: AB B A Off). A failed relay will stop and the SS will beep.

### **4) Receiver Test Procedure**

Connect the black test box to the sting. Make sure it is the only thing plugged in.

Main Menu >> 3. Test Mode >> 4. Receiver test, measure to start the test. Values should be  $500\text{m}\Omega \pm 25\text{m}\Omega$

### **5) Contact Resistance Test Procedure**

Make sure cables are plugged in and remotes are NOT connected. This test can be done during file setup, or go to

SS Main Menu >> 3. Test Mode >> 1. Contact resistance test

1. Low address = 1

2. High address = 29 (should get an HVOVL error on 28-29, if not, check that Tx/Rx cables are not plugged in)

F1 Start/Again

F2 Skip/Continue

Enter 1 for the low address and 28 for the high address. Hit F1 to begin the test. All values should be below  $200\Omega$

### **6) Data Collection Setup & Start Procedure**

Configure reference electrodes (e.g.: Tx/Rx) for the forward measurement configuration or the reverse measurement configuration.

SS Main Menu >> 1. Automatic Mode >> 2. Create Data File >> Enter Data File name using keypad, YYMMDD+A+(Forward or Reverse). A to reflect 1<sup>st</sup> file, B if mistake on A and so on >> Select Command File, hit 'ENTR' >> This brings up a table menu, input the values below:

- Units = Meter
- Scaling Factor = 1
- Start X= 0
- Start Y = 0
- Start Z = 0
- Start Command Line = 1
- Roll along = NO
- End address = OFF (OFF = 0)

Hit 'ENTR' >> Input the following for infinities:

- Tx infinite X = 10000
- Tx infinite Y = 10000
- Tx infinite Z = 0
- Rx infinite X = -10000
- Rx infinite Y = 10000
- Rx infinite Z = 0

Hit 'ENTR' >> enter to continue setup >> 2 for "Dual mode/Swift" >> Cable Address List

If cable section is 1-28, skip this by hitting menu. If not, clear the list and enter 1 for low address, 28 for high address. >> Measurement Settings (see front side) menu to exit >> Contact Resistance Test: Make sure cables are plugged into switchbox and switchbox is plugged in to Sting.

Low is 1, High is 28. F1 to start the test. Make sure the remotes are **not** plugged in.

### **7) Data Download Procedure**

Plug in USB connection from Sting. Make sure Sting is in the main menu screen. Start AGI admin on computer. Click on Super Sting Control Center Button. (center button on upper right) Verify on computer the baud rate is 38400 and port is COMX (the com channel can change)

Hit connect. Right click on new file, select read file. Click ok after download complete. Disconnect and close AGI admin. Zip all downloaded files in a folder, and email to HGI.

### **8) Reciprocal Data Evaluation Procedure**

Using downloaded data sets (both forward and reverse data sets), in MS Excel, combine and resort data to align reciprocal pairs. Compute reciprocal error which equals the % difference for Resistance (V/I) measurements between pairs [ (Forward – Reverse) / Forward \* 100 ]. Compute number of pairs with reciprocal error less than 10% and divide that number by the total number of reciprocal pairs in the combined data file.

### **9) Measurement Error Evaluation Procedure**

Using downloaded data, in MS Excel, compute number of measurements that have measurement errors greater than 4% and divide that number by the total number of readings in the data file. Repeat process for both forward and reverse data set.

## **ATTACHMENT 3**

### **Tabulated Apparent Resistivity Data**

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-03-BC1-02	B-03-BC1-02	B-03-BC1-02	B-03-BC1-02	B-04-BC-01	B-04-BC-01	B-04-BC-01	B-05-BC-01	B-05-BC-01	B-06-BC-01
Receiving Sensor	B-02-BC-01	B-03-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-03-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-06-BC-01	B-07-BC1-02	B-07-BC1-02
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 1																				
9/21/2018	12.92	11.50	13.57	12.51	11.96	11.93	10.62	14.26	13.80	13.79	12.60	12.79	13.24	14.42	13.66	10.90	12.32	13.00	10.11	10.97	10.04
9/28/2018	13.00	11.70	13.85	12.73	12.16	12.06	10.76	14.56	14.07	14.08	12.81	13.04	13.48	14.64	13.89	10.97	12.54	13.26	10.26	11.19	10.20
10/5/2018	12.94	11.53	13.54	12.50	11.96	11.94	10.63	14.26	13.76	13.79	12.58	12.81	13.24	14.40	13.59	10.87	12.33	12.97	10.09	10.93	10.03
10/12/2018	12.96	11.59	13.72	12.62	12.08	12.01	10.68	14.38	13.95	13.94	12.74	12.91	13.39	14.54	13.77	10.92	12.45	13.16	10.20	11.08	10.14
10/19/2018	12.88	11.38	13.41	12.35	11.85	11.84	10.54	14.09	13.63	13.64	12.50	12.69	13.10	14.24	13.44	10.84	12.23	12.85	10.07	10.84	10.06
10/26/2018	12.91	11.44	13.43	12.38	11.87	11.85	10.55	14.14	13.67	13.69	12.52	12.71	13.14	14.30	13.50	10.86	12.27	12.90	10.08	10.87	10.08
11/2/2018	12.96	11.54	13.63	12.53	12.00	11.93	10.65	14.31	13.85	13.84	12.65	12.86	13.28	14.47	13.66	10.90	12.38	13.06	10.17	11.01	10.14
11/9/2018	13.00	11.63	13.73	12.63	12.09	11.99	10.72	14.42	13.96	13.96	12.74	12.94	13.39	14.59	13.77	10.96	12.47	13.17	10.22	11.07	10.16
11/16/2018	13.07	11.77	13.99	12.84	12.29	12.15	10.86	14.67	14.24	14.19	12.97	13.15	13.60	14.87	14.02	11.06	12.67	13.41	10.35	11.24	10.27
11/23/2018	13.14	11.82	14.02	12.85	12.27	12.13	10.89	14.68	14.23	14.21	12.96	13.16	13.62	14.89	14.00	11.07	12.65	13.41	10.36	11.23	10.28
11/30/2018	13.04	11.77	13.95	12.85	12.28	12.12	10.83	14.67	14.22	14.21	12.92	13.10	13.59	14.86	14.02	11.06	12.66	13.38	10.33	11.24	10.25
12/20/2018	13.13	11.90	14.09	12.96	12.33	12.18	10.90	14.80	14.33	14.31	13.01	13.19	13.70	14.95	14.12	11.06	12.74	13.48	10.37	11.30	10.27
12/27/2018	13.08	11.83	13.96	12.85	12.27	12.13	10.83	14.69	14.20	14.22	12.92	13.11	13.61	14.85	14.01	11.03	12.65	13.38	10.34	11.24	10.24
1/3/2019	13.02	11.72	13.85	12.75	12.16	12.06	10.75	14.55	14.06	14.07	12.82	13.01	13.49	14.70	13.89	10.99	12.55	13.26	10.28	11.16	10.20
1/10/2019	12.89	11.45	13.53	12.46	11.93	11.89	10.59	14.21	13.74	13.74	12.57	12.76	13.21	14.35	13.57	10.88	12.32	12.98	10.12	10.93	10.09
1/17/2019	12.92	11.45	13.49	12.44	11.92	11.88	10.58	14.20	13.74	13.74	12.57	12.77	13.19	14.35	13.56	10.87	12.30	12.94	10.12	10.92	10.10
1/24/2019	12.93	11.58	13.83	12.52	11.90	11.84	10.70	14.41	13.89	13.73	12.71	12.95	13.20	14.33	13.63	10.92	12.51	13.00	10.07	11.04	10.19
1/31/2019	12.93	11.58	13.83	12.52	11.90	11.84	10.70	14.41	13.89	13.73	12.71	12.95	13.20	14.33	13.63	10.92	12.51	13.00	10.07	11.04	10.19
2/7/2019	12.91	11.45	13.52	12.43	11.93	11.90	10.57	14.19	13.74	13.74	12.58	12.75	13.19	14.36	13.56	10.89	12.31	12.97	10.13	10.93	10.10
2/14/2019	12.89	11.44	13.52	12.45	11.93	11.90	10.58	14.21	13.73	13.75	12.58	12.74	13.19	14.37	13.56	10.87	12.31	12.97	10.12	10.93	10.11
2/21/2019	12.92	11.47	13.54	12.46	11.92	11.90	10.58	14.21	13.77	13.75	12.58	12.77	13.21	14.38	13.57	10.89	12.32	12.98	10.13	10.93	10.10
2/28/2019	12.85	11.39	13.42	12.37	11.87	11.86	10.52	14.11	13.66	13.68	12.53	12.70	13.13	14.29	13.49	10.85	12.25	12.89	10.08	10.88	10.07
3/6/2019	12.85	11.34	13.34	12.23	11.78	11.82	10.49	14.03	13.49	13.53	12.46	12.58	12.96	14.13	13.37	10.75	12.08	12.75	9.91	10.70	10.01
3/14/2019	12.83	11.37	13.41	12.33	11.81	11.83	10.53	14.09	13.63	13.63	12.47	12.66	13.08	14.22	13.42	10.79	12.15	12.81	9.97	10.83	10.05
3/21/2019	12.85	11.37	13.44	12.38	11.86	11.85	10.52	14.13	13.65	13.65	12.50	12.67	13.11	14.26	13.47	10.83	12.23	12.86	10.05	10.87	10.06
3/28/2019	12.87	11.40	13.45	12.39	11.87	11.86	10.53	14.13	13.68	13.67	12.52	12.69	13.12	14.29	13.47	10.82	12.23	12.90	10.06	10.87	10.07
4/4/2019	12.90	11.47	13.56	12.49	11.95	11.91	10.58	14.23	13.79	13.77	12.59	12.77	13.23	14.39	13.59	10.86	12.32	12.99	10.10	10.94	10.09
4/11/2019	12.86	11.43	13.51	12.47	11.91	11.89	10.52	14.14	13.70	13.69	12.53	12.70	13.14	14.26	13.48	10.83	12.24	12.90	10.07	10.90	10.06
4/18/2019	12.84	11.41	13.51	12.44	11.90	11.87	10.54	14.16	13.70	13.68	12.53	12.68	13.12	14.30	13.48	10.81	12.24	12.88	10.05	10.88	10.05
4/24/2019	12.90	11.55	13.67	12.58	12.03	11.95	10.63	14.32	13.85	13.86	12.65	12.82	13.26	14.46	13.64	10.88	12.36	13.05	10.14	10.99	10.13
5/2/2019	12.91	11.54	13.66	12.56	12.02	11.96	10.61	14.42	13.85	13.82	12.64	12.80	13.27	14.41	13.62	10.88	12.34	13.03	10.12	10.99	10.13
5/9/2019	12.90	11.57	13.74	12.64	12.08	12.00	10.64	14.36	13.93	13.90	12.70	12.83	13.31	14.51	13.69	10.90	12.41	13.10	10.16	11.04	10.15
5/16/2019	12.93	11.58	13.77	12.67	12.09	11.99	10.66	14.41	13.96	13.91	12.71	12.85	13.34	14.53	13.72	10.91	12.42	13.14	10.18	11.05	10.14
5/23/2019	12.94	11.62	13.78	12.68	12.10	11.99	10.66	14.40	13.98	13.93	12.71	12.86	13.34	14.54	13.72	10.90	12.43	13.16	10.19	11.06	10.16
5/30/2019	12.96	11.68	13.88	12.75	12.16	12.04	10.71	14.52	14.05	14.01	12.78	12.94	13.44	14.63	13.81	10.94	12.50	13.24	10.22	11.13	10.18
6/6/2019	12.97	11.66	13.83	12.73	12.12	12.01	10.67	14.46	14.04	13.98	12.74	12.93	13.43	14.60	13.78	10.93	12.49	13.19	10.19	11.09	10.16
6/13/2019	12.93	11.61	13.76	12.67	12.08	11.99	10.65	14.41	13.97	13.91	12.70	12.85	13.34	14.53	13.71	10.90	12.43	13.07	10.17	11.07	10.15
6/20/2019	12.95	11.64	13.84	12.72	12.12	12.00	10.68	14.46	14.00	13.96	12.74	12.90	13.39	14.58	13.76	10.90	12.46	13.19	10.20	11.09	10.17
6/28/2019	12.96	11.66	13.84	12.73	12.12	12.03	10.69	14.52	14.03	13.98	12.75	12.92	13.40	14.60	13.79	10.91	12.48	13.21	10.21	11.11	10.16

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-01-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-02-BC-01	B-03-BC1-02	B-03-BC1-02	B-03-BC1-02	B-03-BC1-02	B-04-BC-01	B-04-BC-01	B-04-BC-01	B-05-BC-01	B-05-BC-01	B-06-BC-01
Receiving Sensor	B-02-BC-01	B-03-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-03-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-04-BC-01	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-05-BC-01	B-06-BC-01	B-07-BC1-02	B-06-BC-01	B-07-BC1-02	B-07-BC1-02
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 1																				
7/3/2019	12.91	11.63	13.82	12.72	12.09	11.99	10.65	14.44	14.01	13.93	12.71	12.86	13.37	14.54	13.73	10.92	12.37	13.15	10.17	11.08	10.16
7/10/2019	12.94	11.71	13.79	12.70	12.11	12.01	10.65	14.45	13.99	13.94	12.71	12.86	13.37	14.56	13.75	10.90	12.45	13.18	10.17	11.08	10.14
7/18/2019	12.89	11.53	13.68	12.60	12.03	11.94	10.57	14.33	13.86	13.83	12.63	12.76	13.27	14.45	13.64	10.87	12.37	13.04	10.15	10.94	10.13
7/24/2019	12.94	11.69	13.89	12.73	12.17	12.04	10.69	14.46	14.06	14.03	12.77	12.91	13.42	14.64	13.82	10.92	12.51	13.23	10.20	11.13	10.18
8/1/2019	12.77	11.29	13.36	12.34	11.78	11.84	10.43	14.00	13.57	13.52	12.37	12.54	13.00	14.10	13.32	10.76	12.14	12.78	9.98	10.80	10.00
8/7/2019	12.85	11.48	13.61	12.54	11.96	11.90	10.55	14.24	13.81	13.76	12.57	12.72	13.21	14.35	13.55	10.84	12.29	12.99	10.09	10.97	10.09
8/14/2019	12.84	11.44	13.58	12.51	11.92	11.87	10.53	14.19	13.75	13.71	12.54	12.70	13.17	14.30	13.51	10.78	12.27	12.95	10.08	10.94	10.09
8/22/2019	12.88	11.51	13.64	12.55	11.98	11.91	10.56	14.27	13.83	13.78	12.56	12.72	13.20	14.35	13.57	10.82	12.30	13.01	10.11	10.97	10.10
8/29/2019	12.85	11.49	13.64	12.57	11.99	11.91	10.55	14.27	13.82	13.77	12.59	12.72	13.21	14.34	13.55	10.83	12.31	13.02	10.11	10.97	10.09
9/4/2019	12.87	11.51	13.67	12.59	11.99	11.91	10.56	14.28	13.86	13.79	12.56	12.73	13.23	14.39	13.59	10.82	12.33	13.04	10.11	10.99	10.11
9/11/2019	12.88	11.53	13.80	12.60	12.01	11.92	10.56	14.29	13.85	13.81	12.60	12.74	13.17	14.37	13.59	10.83	12.32	13.04	10.13	11.00	10.10
9/18/2019	12.86	11.53	13.60	12.62	12.03	11.94	10.56	14.32	13.86	13.80	12.70	12.74	13.26	14.41	13.61	10.84	12.36	13.05	10.13	11.02	10.11
9/25/2019	12.88	11.53	13.68	12.60	12.00	11.92	10.57	14.28	13.86	13.79	12.59	12.74	13.25	14.41	13.60	10.85	12.34	13.05	10.12	10.99	10.10
10/4/2019	12.78	11.36	13.47	12.42	11.84	11.83	10.45	14.08	13.64	13.59	12.45	12.59	13.07	14.18	13.40	10.75	12.18	12.86	10.03	10.86	10.03
10/11/2019	12.80	11.38	13.50	12.44	11.87	11.83	10.47	14.10	13.67	13.61	12.45	12.61	13.09	14.21	13.42	10.77	12.20	12.86	10.05	10.88	10.05
10/18/2019	12.82	11.44	13.56	12.50	11.92	11.88	10.50	14.17	13.75	13.71	12.52	12.66	13.15	14.30	13.50	10.80	12.26	12.95	10.08	10.93	10.08
10/24/2019	12.81	11.42	13.60	12.51	11.93	11.88	10.51	14.18	13.77	13.70	12.52	12.68	13.16	14.31	13.51	10.82	12.27	12.96	10.09	10.94	10.08
11/1/2019	12.82	11.46	13.60	12.54	11.95	11.89	10.51	14.20	13.75	13.72	12.53	12.67	13.18	14.34	13.53	10.81	12.28	12.98	10.10	10.96	10.08
11/8/2019	12.72	11.29	13.38	12.35	11.78	11.79	10.38	13.98	13.54	13.49	12.35	12.51	12.97	14.08	13.30	10.74	12.12	12.76	9.98	10.80	10.00
11/14/2019	12.75	11.33	13.42	12.36	11.82	11.81	10.42	14.02	13.59	13.54	12.40	12.56	13.02	14.13	13.35	10.75	12.14	12.81	10.01	10.83	10.03
11/21/2019	12.56	10.91	12.87	11.87	11.40	11.53	10.12	13.45	13.03	12.99	11.95	12.17	12.54	13.56	12.80	10.59	11.73	12.30	9.77	10.47	9.85
11/26/2019	12.56	10.89	12.88	11.90	11.41	11.55	10.08	13.45	13.04	13.00	11.96	12.13	12.53	13.51	12.76	10.59	11.73	12.30	9.77	10.46	9.84
12/3/2019	12.52	10.81	12.76	11.77	11.31	11.48	10.06	13.34	12.93	12.86	11.88	12.06	12.44	13.43	12.70	10.56	11.66	12.23	9.72	10.40	9.82
12/4/2019	12.50	10.79	12.74	11.77	11.31	11.48	10.04	13.32	12.93	12.88	11.87	12.06	12.44	13.44	12.69	10.55	11.64	12.21	9.72	10.38	9.79
12/5/2019	12.50	10.79	12.72	11.75	11.29	11.47	10.05	13.32	12.91	12.86	11.86	12.06	12.43	13.42	12.68	10.56	11.66	12.19	9.71	10.37	9.81
12/11/2019	12.54	10.87	12.86	11.88	11.40	11.54	10.09	13.44	13.04	12.99	11.96	12.13	12.52	13.55	12.78	10.59	11.74	12.32	9.77	10.44	9.85
12/19/2019	12.55	10.88	12.82	11.85	11.38	11.49	10.09	13.41	12.99	12.96	11.87	12.10	12.50	13.49	12.77	10.58	11.72	12.28	9.74	10.43	9.84
12/20/2019	12.54	10.90	12.86	11.87	11.40	11.54	10.11	13.44	13.03	12.98	11.96	12.14	12.54	13.54	12.79	10.59	11.74	12.31	9.76	10.44	9.83
12/21/2019	12.57	10.91	12.88	11.90	11.42	11.55	10.13	13.47	13.06	13.01	11.97	12.17	12.56	13.57	12.80	10.59	11.75	12.33	9.78	10.47	9.85
12/23/2019	12.55	10.90	12.86	11.87	11.39	11.54	10.11	13.43	13.03	12.97	11.95	12.14	12.53	13.53	12.78	10.58	11.73	12.28	9.77	10.45	9.84
12/28/2019	12.49	10.74	12.64	11.68	11.25	11.43	10.01	13.23	12.82	12.78	11.79	11.99	12.35	13.31	12.59	10.53	11.59	12.12	9.67	10.31	9.79
12/30/2019	12.49	10.79	12.72	11.74	11.29	11.47	10.04	13.29	12.89	12.85	11.85	12.04	12.41	13.39	12.66	10.55	11.63	12.17	9.71	10.36	9.80
12/31/2019	12.50	10.79	12.71	11.68	11.29	11.47	10.04	13.29	12.88	12.83	11.83	12.05	12.39	13.37	12.65	10.53	11.63	12.16	9.70	10.35	9.80
1/3/2020	12.52	10.84	12.77	11.80	11.34	11.49	10.06	13.34	12.93	12.93	11.89	12.09	12.46	13.46	12.71	10.57	11.69	12.23	9.73	10.38	9.82



Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-03-BC1-04	B-03-BC1-04	B-03-BC1-04	B-03-BC1-04	B-04-BC-02	B-04-BC-02	B-04-BC-02	B-05-BC-02	B-05-BC-02	B-06-BC-02
Receiving Sensor	B-02-BC-02	B-03-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-03-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-06-BC-02	B-07-BC1-04	B-07-BC1-04
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 2																				
9/21/2018	14.7085	11.5610	13.4187	12.3027	11.7662	11.8728	11.2944	14.3444	13.7980	13.8248	12.5965	12.7832	13.0822	14.3176	13.3789	11.2578	12.3417	12.7837	10.3379	10.7453	10.7195
9/28/2018	14.8243	11.8051	13.6991	12.5526	12.0089	12.0273	11.4388	14.6232	14.0701	14.0571	12.8015	12.9930	13.3831	14.5414	13.6384	11.3253	12.5263	13.0261	10.4837	10.9757	10.9278
10/5/2018	14.7452	11.5940	13.4251	12.3142	11.7938	11.8717	11.3106	14.2971	13.7595	13.8043	12.5734	12.7573	13.0990	14.2617	13.3433	11.2227	12.3220	12.7426	10.3255	10.7469	10.7192
10/12/2018	14.7585	11.6560	13.5614	12.4433	11.9009	11.9492	11.3923	14.4785	13.9519	13.9175	12.7104	12.9082	13.2282	14.4378	13.5313	11.3029	12.4711	12.9239	10.4385	10.8889	10.9117
10/19/2018	14.6683	11.4566	13.2603	12.1809	11.7045	11.8070	11.2199	14.1435	13.6438	13.6532	12.4699	12.6779	12.9581	14.1093	13.1958	11.2103	12.2108	12.6208	10.2991	10.6901	10.8028
10/26/2018	14.6692	11.4840	13.3238	12.1642	11.7205	11.8173	11.2604	14.2095	13.6164	13.6970	12.5105	12.7227	13.0108	14.1547	13.2582	11.2176	12.2540	12.6641	10.3067	10.7467	10.8500
11/2/2018	14.7495	11.6164	13.4746	12.3587	11.8423	11.8898	11.3444	14.3725	13.8477	13.8535	12.6402	12.8424	13.1443	14.3366	13.4153	11.2606	12.3757	12.8363	10.3996	10.8199	10.8738
11/9/2018	14.8092	11.6976	13.5787	12.4533	11.9414	11.9586	11.4023	14.4924	13.9656	13.9664	12.7339	12.9252	13.2485	14.4367	13.5141	11.3235	12.4543	12.9356	10.4537	10.8983	10.9253
11/16/2018	14.9282	11.8719	13.8382	12.6704	12.1250	12.0799	11.5447	14.7227	14.2390	14.2002	12.9366	13.1228	13.4426	14.7227	13.7593	11.4232	12.6309	13.1778	10.5829	11.0485	11.0328
11/23/2018	14.9670	11.8963	13.8653	12.6639	12.1433	12.0785	11.5788	14.7506	14.2413	14.1945	12.9563	13.1379	13.4772	14.7172	13.7400	11.4315	12.6302	13.1809	10.5906	11.0650	11.0400
11/30/2018	14.9100	11.8813	13.8324	12.6764	12.1292	12.0855	11.5454	14.7294	14.2091	14.2114	12.9279	13.1034	13.4490	14.7015	13.7460	11.3930	12.6424	13.1511	10.5592	11.0642	11.0054
12/20/2018	14.9237	11.9616	13.9285	12.7636	12.1733	12.1025	11.5857	14.8496	14.3039	14.3138	12.9870	13.1665	13.5445	14.7937	13.8505	11.4158	12.7146	13.2269	10.6045	11.1365	11.0245
12/27/2018	14.8695	11.8894	13.8467	12.6885	12.1146	12.0781	11.5258	14.7547	14.2274	14.2260	12.9124	13.0898	13.4600	14.7164	13.7699	11.3904	12.6503	13.1385	10.5549	11.0744	10.9976
1/3/2019	14.8207	11.7857	13.7084	12.5742	12.0090	12.0168	11.4454	14.6229	14.0692	14.0868	12.8080	13.0041	13.3579	14.5517	13.6296	11.3444	12.5530	13.0135	10.5083	10.9761	10.9567
1/10/2019	14.7003	11.5348	13.3804	12.2859	11.7890	11.8637	11.2707	14.2698	13.7579	13.7609	12.5703	12.7447	13.0693	14.2120	13.3092	11.2337	12.3012	12.7193	10.3528	10.7557	10.8450
1/17/2019	14.7122	11.5269	13.3952	12.2662	11.7758	11.8546	11.2604	14.2596	13.7492	13.7530	12.5583	12.7405	13.0498	14.2152	13.3066	11.2314	12.2982	12.7248	10.3584	10.7575	10.8429
1/24/2019	14.7988	11.5776	13.2329	12.5226	11.9147	11.8032	11.2640	14.4069	13.8945	13.7401	12.5801	12.9496	13.2040	14.3326	13.6030	11.3005	12.5127	12.9709	10.3471	11.0149	10.8774
1/31/2019	14.7988	11.5776	13.2329	12.5226	11.9147	11.8032	11.2640	14.4069	13.8945	13.7401	12.5801	12.9496	13.2040	14.3326	13.6030	11.3005	12.5127	12.9709	10.3471	11.0149	10.8774
2/7/2019	14.6776	11.5091	13.3822	12.2780	11.7792	11.8593	11.2439	14.2658	13.7520	13.7585	12.5662	12.7342	13.0462	14.2210	13.2973	11.2433	12.2981	12.7184	10.3608	10.7607	10.8455
2/14/2019	14.6994	11.5304	13.3831	12.2853	11.7791	11.8609	11.2505	14.2578	13.7669	13.7676	12.5825	12.7389	13.0495	14.2299	13.3047	11.2248	12.2903	12.7285	10.3522	10.7508	10.8459
2/21/2019	14.7023	11.5349	13.4020	12.2788	11.7948	11.8683	11.2580	14.2733	13.7710	13.7775	12.5752	12.7513	13.0739	14.2262	13.3206	11.2414	12.2972	12.7302	10.3592	10.7497	10.8532
2/28/2019	14.6481	11.4541	13.2864	12.1926	11.7234	11.8229	11.1975	14.1712	13.6585	13.6755	12.4921	12.6803	12.9888	14.1287	13.2285	11.1990	12.2361	12.6577	10.3134	10.7096	10.8260
3/6/2019	14.6412	11.4275	13.2024	12.0681	11.6318	11.7829	11.1584	14.0687	13.5272	13.5636	12.4167	12.5769	12.8306	14.0012	13.1346	11.1205	12.0659	12.5200	10.1419	10.5327	10.7705
3/14/2019	14.6609	11.4605	13.3052	12.1703	11.6619	11.8188	11.2097	14.1530	13.6024	13.6486	12.5037	12.6623	12.9513	14.1052	13.1642	11.1311	12.1228	12.6101	10.1780	10.5891	10.7886
3/21/2019	14.6263	11.4612	13.2861	12.2117	11.7110	11.8143	11.1870	14.1703	13.6929	13.6910	12.4945	12.6499	12.9599	14.1112	13.2274	11.1719	12.2130	12.6449	10.2845	10.7010	10.8169
3/28/2019	14.6580	11.4753	13.3335	12.2444	11.7284	11.8205	11.1968	14.1962	13.7057	13.7017	12.5066	12.6625	12.9827	14.1291	13.2324	11.1911	12.2219	12.6677	10.2804	10.6983	10.8295
4/4/2019	14.6896	11.5555	13.4474	12.3254	11.8068	11.8703	11.2458	14.2993	13.8114	13.8086	12.5588	12.7486	13.0854	14.2578	13.3361	11.2271	12.2998	12.7663	10.3253	10.7759	10.8642
4/11/2019	14.6556	11.5206	13.4103	12.3078	11.7763	11.8585	11.2185	14.2223	13.7174	13.7219	12.5128	12.6492	12.9942	14.1598	13.2603	11.1852	12.2337	12.6987	10.3007	10.7252	10.8266
4/18/2019	14.6524	11.5117	13.3946	12.2924	11.7870	11.8451	11.2205	14.2334	13.7451	13.7294	12.5347	12.6878	13.0216	14.1563	13.2431	11.1893	12.2277	12.6962	10.3006	10.7167	10.8197
4/24/2019	14.6885	11.6284	13.5641	12.4318	11.8952	11.9141	11.3016	14.3921	13.9046	13.9071	12.6320	12.7896	13.1426	14.3360	13.4006	11.2208	12.3416	12.8247	10.3567	10.8368	10.8981
5/2/2019	14.6808	11.6202	13.5421	12.4338	11.8773	11.9058	11.2836	14.3796	13.8951	13.8470	12.6165	12.7831	13.1417	14.3010	13.3853	11.2314	12.3278	12.8024	10.3566	10.8217	10.8904
5/9/2019	14.6974	11.6730	13.6060	12.4896	11.9349	11.9417	11.3299	14.4745	13.9297	13.9310	12.6663	12.8252	13.1916	14.3621	13.4460	11.2534	12.3855	12.8692	10.3908	10.8771	10.8847
5/16/2019	14.7272	11.6962	13.6646	12.5484	11.9582	11.9601	11.3352	14.4955	13.9994	13.9640	12.7006	12.8334	13.2139	14.4061	13.4818	11.2530	12.4189	12.9062	10.4122	10.9048	10.9020
5/23/2019	14.7336	11.7239	13.6745	12.5551	11.9815	11.9697	11.3425	14.5144	14.0299	13.9879	12.7005	12.8574	13.2279	14.4225	13.5030	11.2726	12.4255	12.9398	10.4024	10.9061	10.9055

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-01-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-02-BC-02	B-03-BC1-04	B-03-BC1-04	B-03-BC1-04	B-03-BC1-04	B-04-BC-02	B-04-BC-02	B-04-BC-02	B-05-BC-02	B-05-BC-02	B-06-BC-02
Receiving Sensor	B-02-BC-02	B-03-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-03-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-04-BC-02	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-05-BC-02	B-06-BC-02	B-07-BC1-04	B-06-BC-02	B-07-BC1-04	B-07-BC1-04
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 2																				
5/30/2019	14.7557	11.7818	13.7701	12.6175	12.0284	12.0055	11.3873	14.6044	14.0994	14.0633	12.7762	12.9180	13.3026	14.5166	13.5830	11.2752	12.4822	13.0165	10.4512	10.9623	10.9537
6/6/2019	14.7102	11.7421	13.7419	12.5884	11.9903	11.9678	11.3672	14.5726	14.0469	14.0176	12.7461	12.8811	13.2522	14.4648	13.5329	11.2754	12.4516	12.9732	10.4084	10.9171	10.9216
6/13/2019	14.7218	11.7168	13.6858	12.5580	11.9677	11.9635	11.3251	14.5179	14.0097	13.9636	12.7118	12.8413	13.2289	14.4019	13.4767	11.2639	12.4337	12.9439	10.3942	10.9047	10.9126
6/20/2019	14.7291	11.7433	13.7265	12.5718	11.9487	11.9774	11.3493	14.5751	14.0564	13.9990	12.7384	12.8553	13.2509	14.4703	13.5391	11.2419	12.4417	12.9757	10.4243	10.9318	10.8987
6/28/2019	14.7353	11.7442	13.7454	12.6010	12.0121	11.9833	11.3558	14.5820	14.0776	14.0263	12.7489	12.8837	13.2804	14.4868	13.5584	11.2687	12.4763	12.9718	10.4306	10.9481	10.9215
7/3/2019	14.7398	11.7060	13.7248	12.5895	11.9685	11.9606	11.3395	14.5313	14.0408	13.9800	12.7049	12.8703	13.2616	14.4395	13.5165	11.2741	12.4558	12.9643	10.4140	10.9313	10.9299
7/10/2019	14.7006	11.7206	13.7143	12.5759	11.9760	11.9415	11.3318	14.5401	14.0303	13.9738	12.7143	12.8685	13.2627	14.4533	13.5260	11.2468	12.4302	12.9519	10.4131	10.9209	10.9203
7/18/2019	14.6673	11.6421	13.5964	12.4772	11.9130	11.9076	11.2618	14.4107	13.9270	13.8831	12.6276	12.7633	13.1449	14.3108	13.3993	11.1949	12.3491	12.8578	10.3531	10.8435	10.8814
7/24/2019	14.6908	11.7473	13.7710	12.6218	12.0422	11.9978	11.3529	14.5825	14.1254	14.1824	12.7743	12.8859	13.2848	14.5220	13.5883	11.2473	12.4955	13.0051	10.4416	10.9748	10.9405
8/1/2019	14.5432	11.3864	13.3140	12.2234	11.6640	11.7667	11.0931	14.1042	13.6377	13.5803	12.3556	12.5263	12.8916	14.0040	13.1180	11.1224	12.1131	12.5559	10.2088	10.6450	10.7835
8/7/2019	14.6037	11.5609	13.5283	12.4156	11.8185	11.8814	11.2150	14.3314	13.8595	13.7850	12.5557	12.7069	13.0967	14.2129	13.3109	11.1949	12.2786	12.7946	10.3081	10.7888	10.8532
8/14/2019	14.6048	11.5388	13.4930	12.3852	11.8156	11.8659	11.1816	14.4187	13.8059	13.7498	12.5556	12.6566	13.0458	14.1836	13.2919	11.1630	12.2508	12.7488	10.2940	10.7668	10.8499
8/22/2019	14.6241	11.5968	13.5346	12.4450	11.8763	11.9047	11.2293	14.3792	13.8957	13.8226	12.5897	12.7193	13.1079	14.2622	13.3609	11.1810	12.2993	12.7866	10.3207	10.8157	10.8695
8/29/2019	14.6112	11.5500	13.5540	12.3233	11.8786	11.8895	11.2279	14.3606	13.8722	13.8175	12.5779	12.7247	13.1009	14.2652	13.3459	11.1771	12.2995	12.8160	10.3237	10.8171	10.8542
9/4/2019	14.5783	11.5978	13.5662	12.4500	11.8770	11.9055	11.2370	14.3745	13.9091	13.8507	12.5889	12.7243	13.1083	14.2886	13.3570	11.1582	12.2959	12.8071	10.3196	10.8228	10.8652
9/11/2019	14.6122	11.6055	13.5641	12.4554	11.8876	11.9012	11.2533	14.3859	13.8899	13.8409	12.5861	12.7365	13.1222	14.2729	13.3727	11.1982	12.3360	12.8281	10.3321	10.8277	10.8635
9/18/2019	14.6282	11.5980	13.6286	12.4990	11.8969	11.9070	11.2644	14.4307	13.9284	13.8416	12.6029	12.7398	13.1338	14.2985	13.3938	11.1783	12.3150	12.8532	10.3440	10.8337	10.8595
9/25/2019	14.6377	11.6131	13.5740	12.4667	11.8855	11.9066	11.2382	14.3977	13.9244	13.8550	12.6074	12.7257	13.1227	14.2845	13.3817	11.1876	12.3193	12.8412	10.3421	10.8278	10.8490
10/4/2019	14.5198	11.4538	13.3858	12.3030	11.7315	11.8070	11.1141	14.1757	13.7108	13.6299	12.4355	12.5808	12.9654	14.0728	13.1972	11.1359	12.1816	12.6438	10.2495	10.7237	10.7923
10/11/2019	14.5531	11.4751	13.4105	12.3173	11.7619	11.8015	11.1313	14.1962	13.7118	13.6621	12.4526	12.5984	12.9773	14.1131	13.2261	11.1139	12.1824	12.6853	10.2657	10.7187	10.8084
10/18/2019	14.5720	11.5226	13.4507	12.3671	11.8005	11.8496	11.1451	14.2640	13.7877	13.7419	12.5174	12.6344	13.0209	14.1851	13.2808	11.1499	12.2277	12.7258	10.2993	10.7723	10.8454
10/24/2019	14.5733	11.5364	13.5006	12.3788	11.8176	11.8598	11.1681	14.2729	13.8021	13.7486	12.5249	12.6780	13.0560	14.2044	13.2942	11.1584	12.2598	12.7493	10.3102	10.7844	10.8332
11/1/2019	14.5713	11.5466	13.4899	12.3939	11.8272	11.8635	11.1720	14.2903	13.7944	13.7543	12.5254	12.6851	13.0605	14.2122	13.3143	11.1565	12.2708	12.7652	10.3211	10.8041	10.8440
11/8/2019	14.4751	11.3975	13.3068	12.2423	11.6839	11.7732	11.0494	14.0910	13.6107	13.5606	12.3648	12.5220	12.8923	13.9751	13.1021	11.0962	12.1092	12.5607	10.2096	10.6496	10.7724
11/14/2019	14.4829	11.4143	13.3445	12.2517	11.7064	11.7817	11.0839	14.1299	13.6515	13.5989	12.3952	12.5625	12.9007	14.0265	13.1341	11.1238	12.1347	12.5836	10.2460	10.6819	10.7997
11/21/2019	14.3264	11.0400	12.8195	11.7849	11.3071	11.5271	10.7865	13.5578	13.1019	13.0565	12.0003	12.1578	12.4475	13.4742	12.6143	10.9538	11.7443	12.1310	9.9992	10.3179	10.6228
11/26/2019	14.3103	10.9690	12.8270	11.8012	11.3139	11.5462	10.7085	13.5571	13.1054	13.0574	11.9859	12.2074	12.5405	13.4765	12.6231	10.9503	11.7326	12.1186	9.9948	10.3148	10.6113
12/3/2019	14.2759	10.9251	12.6945	11.6708	11.2231	11.4806	10.7257	13.4378	13.0093	12.9552	11.8996	12.0691	12.3683	13.3505	12.4969	10.9260	11.6588	12.0262	9.9559	10.2451	10.5884
12/4/2019	14.2530	10.9196	12.6526	11.6646	11.2022	11.4703	10.7003	13.4297	12.9767	12.9350	11.8900	12.0543	12.3303	13.3590	12.5121	10.9160	11.6677	12.0289	9.9395	10.2244	10.5769
12/5/2019	14.2476	10.9000	12.6556	11.6498	11.2013	11.4675	10.6973	13.4197	12.9748	12.9172	11.8778	12.0582	12.3331	13.3441	12.4955	10.9078	11.6536	12.0213	9.9389	10.2247	10.5755
12/11/2019	14.3112	10.9826	12.7920	11.7619	11.2989	11.5300	10.7359	13.5462	13.0946	13.0294	11.9726	12.1157	12.4139	13.4288	12.5656	10.9425	11.7442	12.1232	9.9912	10.3070	10.6173
12/19/2019	14.2823	10.9762	12.7402	11.7329	11.2783	11.5204	10.7614	13.5080	13.0365	13.0067	11.9530	12.1062	12.4035	13.4231	12.5888	10.9160	11.7131	12.0793	9.9610	10.2891	10.5978
12/20/2019	14.2999	11.0153	12.8007	11.7795	11.3054	11.5440	10.7765	13.5569	13.0989	13.0423	11.9781	12.1482	12.4388	13.4588	12.6185	10.9453	11.7412	12.1289	9.9895	10.3076	10.6151
12/21/2019	14.3071	11.0335	12.8296	11.7974	11.3236	11.5484	10.7955	13.5943	13.1227	13.0713	12.0004	12.1675	12.4637	13.4701	12.6354	10.9508	11.7564	12.1865	10.0005	10.3205	10.6221
12/23/2019	14.2879	11.0036	12.7835	11.7637	11.2972	11.5270	10.7777	13.5468	13.0774	13.0340	11.9779	12.1461	12.4279	13.4499	12.6006	10.9325	11.7325	12.1192	9.9801	10.2987	10.6139
12/28/2019	14.2276	10.8623	12.5964	11.5921	11.1494	11.4351	10.6732	13.3447	12.8857	12.8357	11.8217	11.9955	12.2595	13.2431	12.4075	10.8863	11.5983	11.9354	9.8936	10.1760	10.5397
12/30/2019	14.2629	10.9020	12.6506	11.6387	11.1998	11.4731	10.7044	13.4040	12.9498	12.9010	11.8700	12.0243	12.3202	13.2973	12.4726	10.9043	11.6307	11.9994	9.9328	10.2124	10.5726
12/31/2019	14.2524	10.9060	12.6526	11.6438	11.1977	11.4689	10.6940	13.3967	12.9459	12.9024	11.8678	12.0332	12.3049	13.3045	12.4607	10.9002	11.6219	11.9954	9.9284	10.2192	10.5696
1/3/2020	14.2489	10.9472	12.7175	11.6965	11.2363	11.4954	10.7316	13.4590	13.0111	12.9624	11.9115	12.0838	12.3713	13.3737	12.5356	10.9192	11.6769	12.0567	9.9541	10.2543	10.5917

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-03-BC2-02	B-03-BC2-02	B-03-BC2-02	B-03-BC2-02	B-04-BC-03	B-04-BC-03	B-04-BC-03	B-05-BC-03	B-05-BC-03	B-06-BC-03
Receiving Sensor	B-02-BC-03	B-03-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-03-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-06-BC-03	B-07-BC2-02	B-07-BC2-02
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 3																				
9/21/2018	15.6416	11.6310	13.2831	12.1471	11.6403	12.1329	11.6868	14.0913	13.5985	13.6656	12.6650	12.7255	13.0411	14.2674	13.3326	11.9733	12.4369	12.5993	10.6172	10.6233	10.6742
9/28/2018	15.7113	11.8623	13.5361	12.4165	11.8315	12.2327	11.8302	14.3694	13.8981	13.8919	12.8884	12.9595	13.3385	14.5897	13.6360	12.0963	12.6227	12.8581	10.7663	10.8444	10.9877
10/5/2018	15.6507	11.6473	13.2108	12.1470	11.6323	12.1305	11.6752	14.0979	13.5475	13.6649	12.6466	12.7357	13.0750	14.2590	13.3090	12.0017	12.4202	12.6092	10.6096	10.6269	10.6728
10/12/2018	15.6521	11.7442	13.3567	12.2740	11.7584	12.2256	11.7742	14.2791	13.7378	13.7774	12.7864	12.8480	13.2086	14.3888	13.4302	12.0528	12.5585	12.7561	10.7013	10.7422	11.1292
10/19/2018	15.5938	11.5251	13.0759	12.0149	11.5320	12.0468	11.6091	13.9269	13.4072	13.4866	12.5625	12.6096	12.9157	14.1040	13.1413	11.9404	12.3127	12.4560	10.5763	10.5288	11.0183
10/26/2018	15.5831	11.5497	13.1342	12.0524	11.5767	12.0767	11.6495	13.9914	13.4890	13.5319	12.5843	12.6698	12.9757	14.1619	13.1995	11.9491	12.3414	12.5194	10.5964	10.5682	11.0533
11/2/2018	15.6667	11.6913	13.2989	12.2053	11.6840	12.1480	11.7159	14.1423	13.6174	13.6779	12.7003	12.7667	13.1035	14.3277	13.3499	12.0002	12.4706	12.6675	10.6753	10.6692	11.0999
11/9/2018	15.6901	11.7597	13.4045	12.2942	11.7596	12.1967	11.7763	14.2663	13.7397	13.7941	12.8115	12.8483	13.1922	14.4467	13.4563	12.0594	12.5512	12.7459	10.7206	10.7456	11.1261
11/16/2018	15.8212	11.9429	13.6467	12.4933	11.9510	12.3361	11.9457	14.5034	14.0074	14.0224	13.0196	13.0627	13.4078	14.7055	13.6898	12.1692	12.7472	13.0016	10.8735	10.9128	11.2438
11/23/2018	15.8503	11.9569	13.6608	12.4995	11.9445	12.3583	11.9732	14.5296	14.0180	14.0113	13.0353	13.0716	13.4128	14.7156	13.7076	12.1778	12.7296	13.0131	10.8611	10.9047	11.2566
11/30/2018	15.8039	11.9442	13.6347	12.5088	11.9493	12.3372	11.9285	14.5151	13.9800	14.0260	12.9682	13.0309	13.4246	14.7014	13.6847	12.1463	12.7331	12.9699	10.8349	10.8976	11.2276
12/20/2018	15.8259	12.0388	13.7383	12.6065	12.0247	12.3680	11.9569	14.6230	14.0830	14.1355	13.0536	13.1253	13.5162	14.8263	13.8006	12.1567	12.8177	13.0594	10.8809	10.9759	11.2329
12/27/2018	15.7658	11.9553	13.6309	12.5194	11.9489	12.3296	11.8933	14.5299	13.9836	14.0371	12.9757	13.0316	13.4282	14.7191	13.7000	12.1238	12.7387	12.9893	10.8542	10.9269	11.2079
1/3/2019	15.7098	11.8405	13.5105	12.4030	11.8553	12.2629	11.8089	14.3926	13.8662	13.9208	12.8772	12.9184	13.3013	14.5827	13.5690	12.0775	12.6417	12.8623	10.7786	10.8257	11.1612
1/10/2019	15.5929	11.6001	13.1849	12.1160	11.6128	12.1050	11.6338	14.0634	13.5431	13.5913	12.6301	12.6797	13.0292	14.2213	13.2659	11.9689	12.4059	12.5639	10.6334	10.6139	11.0570
1/17/2019	15.6025	11.5920	13.1857	12.1152	11.6157	12.1027	11.6360	14.0517	13.5267	13.5908	12.6111	12.6526	13.0060	14.2031	13.2442	11.9654	12.3979	12.5510	10.6348	10.6044	11.0553
1/24/2019	15.5276	11.5771	13.2317	12.5222	11.9083	12.0895	11.5707	14.4133	13.9018	13.7495	12.5946	12.9497	13.2040	14.3313	13.6030	12.0676	12.5114	12.4307	10.6157	10.5912	11.0624
1/31/2019	15.7147	11.5771	13.2317	11.9530	11.9083	12.0895	11.5707	14.4133	13.9018	13.7495	12.5946	12.9497	13.2040	14.3313	13.6030	12.0676	12.5114	12.4307	10.6157	10.5912	11.0624
2/7/2019	15.5496	11.5742	13.2132	12.1361	11.6077	12.1020	11.6383	14.0565	13.5381	13.5798	12.6169	12.6400	12.9769	14.2037	13.2337	11.9515	12.3892	12.5499	10.6381	10.6201	11.0582
2/14/2019	15.5796	11.5786	13.2266	12.1250	11.6103	12.0929	11.5973	14.0474	13.5506	13.5977	12.6191	12.6439	13.0195	14.2341	13.2537	11.9526	12.3788	12.5771	10.6230	10.6045	11.0559
2/21/2019	15.5643	11.5925	13.2401	12.1476	11.6103	12.1013	11.6131	14.0889	13.5807	13.6239	12.6222	12.6822	13.0261	14.2516	13.2677	11.9519	12.3853	12.5852	10.6243	10.5924	11.0522
2/28/2019	15.5158	11.5262	13.1207	12.0425	11.5415	12.0486	11.5520	13.9604	13.4497	13.5096	12.5467	12.5884	12.9369	14.1329	13.1951	11.9328	12.3300	12.4886	10.5817	10.5546	11.0339
3/6/2019	15.5242	11.4717	13.0616	11.9448	11.4586	12.0097	11.5298	13.8703	13.3220	13.3937	12.5052	12.5085	12.7928	13.9923	13.0603	11.8405	12.1621	12.3452	10.4229	10.4183	10.9728
3/14/2019	15.5570	11.5456	13.1328	12.0167	11.5119	12.0569	11.5757	13.9658	13.4263	13.4672	12.5477	12.5844	12.8728	14.0972	13.1412	11.8593	12.2297	12.4527	10.4854	10.4740	10.9671
3/21/2019	15.5040	11.5181	13.1377	12.0689	11.5392	12.0480	11.5514	13.9882	13.4674	13.5066	12.5528	12.5805	12.9343	14.1162	13.1848	11.9160	12.2955	12.4904	10.5411	10.5366	11.0229
3/28/2019	15.5241	11.5336	13.1778	12.0980	11.5703	12.0598	11.5651	13.9942	13.4978	13.5301	12.5761	12.5863	12.9395	14.1376	13.1908	11.9018	12.3031	12.5196	10.5614	10.5573	11.0386
4/4/2019	15.5838	11.6172	13.2548	12.1669	11.6321	12.1000	11.6141	14.1009	13.6169	13.6195	12.6470	12.6505	13.0263	14.2537	13.2965	11.9353	12.3789	12.5889	10.6115	10.6218	11.0752
4/11/2019	15.5161	11.5877	13.2913	12.1945	11.6400	12.0914	11.5815	14.0534	13.5810	13.5819	12.6027	12.5992	12.9846	14.1922	13.2314	11.9173	12.3328	12.5153	10.5762	10.5859	11.0391
4/18/2019	15.5407	11.5938	13.2997	12.1895	11.6390	12.0863	11.5833	14.0380	13.5565	13.5771	12.5966	12.6100	12.9895	14.1775	13.2114	11.9312	12.3237	12.5334	10.5754	10.5779	11.0216
4/24/2019	15.5860	11.7258	13.4135	12.3152	11.7387	12.1530	11.6610	14.1544	13.7335	13.7522	12.7124	12.6879	13.0978	14.3617	13.3834	11.9630	12.4551	12.6766	10.6440	10.6862	11.1103
5/2/2019	15.5497	11.7012	13.4150	12.3068	11.7267	12.1725	11.6270	14.1955	13.7121	13.7195	12.7151	12.6912	13.0938	14.3262	13.3586	11.9666	12.4363	12.6710	10.6486	10.6976	11.1014
5/9/2019	15.5872	11.7519	13.5300	12.4025	11.7999	12.1977	11.6605	14.2706	13.7835	13.7916	12.7573	12.7475	13.1361	14.3942	13.4299	11.9849	12.4730	12.7105	10.6565	10.7307	11.1160
5/16/2019	15.6053	11.7988	13.5580	12.4080	11.8212	12.2023	11.7011	14.3249	13.8196	13.8196	12.7674	12.7944	13.1798	14.4254	13.4659	11.9928	12.5210	12.7943	10.6879	10.7582	11.1227
5/23/2019	15.6001	11.8003	13.5782	12.4361	11.8652	12.2112	11.7103	14.3574	13.8341	13.8457	12.7943	12.7883	13.2180	14.4614	13.4840	11.9835	12.5274	12.7892	10.6897	10.7640	11.1195

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-01-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-02-BC-03	B-03-BC2-02	B-03-BC2-02	B-03-BC2-02	B-03-BC2-02	B-04-BC-03	B-04-BC-03	B-04-BC-03	B-05-BC-03	B-05-BC-03	B-06-BC-03
Receiving Sensor	B-02-BC-03	B-03-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-03-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-04-BC-03	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-05-BC-03	B-06-BC-03	B-07-BC2-02	B-06-BC-03	B-07-BC2-02	B-07-BC2-02
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 3																				
5/30/2019	15.6186	11.8574	13.6680	12.5129	11.8966	12.2612	11.7422	14.4266	13.9112	13.9212	12.8603	12.8375	13.2729	14.5430	13.5488	12.0002	12.5863	12.8632	10.7180	10.8234	11.1425
6/6/2019	15.5974	11.8161	13.5924	12.4580	11.8509	12.2143	11.7082	14.3969	13.8684	13.8518	12.8181	12.8217	13.2501	14.4990	13.5214	11.9943	12.5460	12.8193	10.6974	10.7961	11.1427
6/13/2019	15.5591	11.7810	13.6014	12.4661	11.8221	12.2049	11.6902	14.3423	13.8356	13.8122	12.7873	12.7993	13.2228	14.4247	13.4608	11.9895	12.5066	12.7908	10.6736	10.7636	11.1082
6/20/2019	15.6134	11.8292	13.6377	12.4881	11.8666	12.2231	11.7178	14.4096	13.8925	13.8697	12.8224	12.8103	13.2339	14.4963	13.5167	11.9833	12.5523	12.8238	10.7073	10.7936	11.1156
6/28/2019	15.6168	11.8369	13.6551	12.4949	11.8707	12.2293	11.7121	14.4044	13.8901	13.8910	12.8022	12.8235	13.2588	14.5273	13.5306	11.9904	12.5703	12.8506	10.7115	10.8128	11.1555
7/3/2019	15.5804	11.8192	13.6141	12.4622	11.8296	12.2159	11.7108	14.3755	13.8858	13.8359	12.8032	12.7872	13.2481	14.4661	13.4942	11.9768	12.5249	12.8197	10.6806	10.7796	11.1082
7/10/2019	15.5926	11.8024	13.6139	12.4751	11.8450	12.2104	11.6992	14.3885	13.8844	13.8480	12.7997	12.7858	13.2185	14.4681	13.5009	11.9807	12.5320	12.8347	10.6925	10.7919	11.1126
7/18/2019	15.5482	11.7204	13.5075	12.3690	11.7657	12.1607	11.6108	14.2739	13.7579	13.7520	12.7260	12.6866	13.1308	14.3815	13.3930	11.9297	12.4501	12.7258	10.6031	10.7170	11.1139
7/24/2019	15.5964	11.8452	13.6674	12.5328	11.9031	12.2482	11.6979	14.3977	13.9470	13.9122	12.8573	12.8156	13.2824	14.5385	13.5622	11.9722	12.5663	12.8982	10.7013	10.8322	11.1393
8/1/2019	15.4221	11.5001	13.2179	12.1240	11.5320	12.0185	11.3962	13.9737	13.4715	13.4530	12.4503	12.4948	12.8945	14.0622	13.1079	11.8378	12.2456	12.4058	10.4749	10.5153	10.9952
8/7/2019	15.4855	11.6432	13.4182	12.3539	11.6883	12.1300	11.5791	14.1870	13.6704	13.6528	12.6568	12.6476	13.0748	14.2567	13.3087	11.9143	12.3934	12.6512	10.5948	10.6619	11.0493
8/14/2019	15.5079	11.6504	13.4246	12.3048	11.6728	12.1170	11.5600	14.1323	13.6677	13.6442	12.6084	12.6588	13.0434	14.2419	13.2801	11.8671	12.3464	12.6150	10.5299	10.6448	11.0372
8/22/2019	15.5114	11.6893	13.4760	12.3332	11.7274	12.1399	11.5874	14.2346	13.6878	13.6804	12.6866	12.6406	13.0881	14.2875	13.3160	11.9035	12.3985	12.6847	10.5979	10.6676	11.0833
8/29/2019	16.6082	11.9706	13.6553	12.5397	11.8110	12.4929	12.0390	14.1347	13.6739	13.4350	12.4103	12.5435	13.0763	14.1567	13.2397	13.5996	12.5508	12.7294	10.8949	10.8730	13.3271
9/4/2019	16.5935	11.9618	13.6482	12.5288	11.8228	12.4996	12.0323	14.1535	13.6176	13.4500	12.3844	12.5659	12.9943	14.1703	13.2751	13.5590	12.4628	12.7671	10.9220	10.9300	13.3873
9/11/2019	15.5259	11.7106	13.4949	12.3804	11.7367	12.1485	11.5681	14.2558	13.7643	13.7353	12.7765	12.6699	13.1315	14.3631	13.4015	11.8564	12.4160	12.6863	10.6622	10.7015	11.0690
9/18/2019	15.5171	11.7316	13.5228	12.3878	11.7776	12.1591	11.5640	14.2815	13.7544	13.7212	12.7318	12.6912	13.1659	14.4084	13.4166	11.8727	12.4252	12.7095	10.6005	10.7086	11.0955
9/25/2019	15.5054	11.7042	13.5196	12.3861	11.7431	12.1616	11.5469	14.2552	13.7462	13.7147	12.6774	12.6538	13.1516	14.3843	13.4044	11.8789	12.3954	12.7045	10.6052	10.6928	11.0816
10/4/2019	15.3908	11.5510	13.3041	12.1990	11.5968	12.0602	11.4153	14.0405	13.5410	13.5210	12.5324	12.5083	12.9800	14.1827	13.2228	11.8039	12.2688	12.5121	10.5225	10.5850	11.0232
10/11/2019	15.4166	11.5679	13.3303	12.2279	11.6172	12.0603	11.4280	14.0356	13.5666	13.5276	12.5237	12.5233	12.9892	14.2116	13.2414	11.8149	12.2721	12.5308	10.5196	10.5779	11.0197
10/18/2019	15.4352	11.6026	13.3658	12.2704	11.6564	12.0975	11.4520	14.0940	13.6300	13.6049	12.5964	12.5650	13.0439	14.2739	13.3046	11.8246	12.3192	12.5704	10.5622	10.6357	11.0586
10/24/2019	15.4268	11.6224	13.4020	12.2857	11.6779	12.1075	11.4688	14.1337	13.6529	13.6156	12.5902	12.5890	13.0740	14.3069	13.3388	11.8522	12.3558	12.6150	10.5723	10.6379	11.0388
11/1/2019	15.4263	11.6405	13.4221	12.2953	11.6807	12.0979	11.4715	14.1475	13.6534	13.6085	12.5958	12.5986	13.0709	14.3081	13.3310	11.8625	12.3597	12.6161	10.5882	10.6605	11.0506
11/8/2019	15.3324	11.5046	13.2426	12.1603	11.5730	12.0226	11.3440	13.9683	13.4770	13.4477	12.4577	12.4679	12.9070	14.0947	13.1538	11.8108	12.2108	12.4665	10.4850	10.5270	10.9870
11/14/2019	15.3599	11.5307	13.2997	12.1900	11.5903	12.0507	11.3707	13.9742	13.4916	13.4768	12.4864	12.5015	12.9548	14.1427	13.1848	11.8429	12.2482	12.4984	10.5167	10.5607	10.9971
11/21/2019	15.1731	11.1255	12.7799	11.7316	11.1982	11.7897	11.0823	13.4593	12.9801	12.9412	12.0869	12.1033	12.4794	13.5755	12.6641	11.6671	11.8640	12.0168	10.2803	10.2020	10.8261
11/26/2019	15.1473	10.7510	12.7903	11.7362	11.2114	11.7988	10.4578	13.4441	12.9888	12.9520	12.0785	11.7952	12.3630	13.5144	12.5761	11.6500	11.8631	12.0407	10.2766	10.1993	10.8344
12/3/2019	15.1296	11.0251	12.6738	11.6226	11.1178	11.7415	11.0787	13.3438	12.8738	12.8486	11.9976	12.0150	12.3390	13.3961	12.4839	11.6238	11.7661	11.9411	10.2278	10.1301	10.8102
12/4/2019	15.0990	10.9896	12.6240	11.5902	11.0778	11.7180	11.0661	13.3218	12.8578	12.8085	11.9890	12.0056	12.3298	13.3852	12.4905	11.6193	11.7652	11.9403	10.2167	10.1337	10.8074
12/5/2019	15.1052	10.9844	12.5953	11.5759	11.0610	11.7269	11.0634	13.3084	12.8460	12.8049	11.9768	12.0014	12.3199	13.3705	12.4785	11.6125	11.7639	11.9280	10.2054	10.1049	10.7883
12/11/2019	15.1717	10.8710	12.7574	11.6930	11.1593	11.7746	10.5970	13.4273	12.9556	12.9115	12.0610	11.6666	12.1029	13.0866	12.2076	11.6459	11.8497	12.0231	10.2643	10.1783	10.8180
12/19/2019	15.1241	11.0699	12.7250	11.6741	11.1583	11.7789	11.1038	13.4045	12.9396	12.9119	12.0477	12.0723	12.4032	13.4308	12.5846	11.6195	11.8125	11.9152	10.2597	10.1758	10.8049
12/20/2019	15.1489	11.1163	12.7706	11.7127	11.1918	11.7952	11.1384	13.4467	12.9818	12.9392	12.0834	12.0519	12.4398	13.4892	12.5897	11.6482	11.8512	12.0257	10.2546	10.1801	10.8255
12/21/2019	15.1638	11.1497	12.7992	11.7387	11.1998	11.8073	10.9526	13.4796	13.0055	12.9642	12.0991	12.1108	12.5793	13.7455	12.8100	11.6599	11.8643	12.0599	10.2841	10.2015	10.8388
12/23/2019	15.1501	11.1204	12.7677	11.7074	11.1791	11.7899	11.0294	13.4421	12.9910	12.9151	12.0706	12.0884	12.4648	13.5621	12.5865	11.6419	11.8354	12.0247	10.2651	10.1767	10.8187
12/28/2019	15.1066	10.9713	12.5650	11.5345	11.0301	11.7086	10.8812	13.2476	12.7810	12.7446	11.9265	11.9443	12.3422	13.4408	12.5286	11.5776	11.7095	11.8415	10.1716	10.0718	10.7655
12/30/2019	15.1216	11.0126	12.6279	11.5904	11.0760	11.7269	10.9160	13.2988	12.8377	12.7835	11.9772	11.9739	12.3911	13.5051	12.5926	11.6053	11.7480	11.9021	10.1953	10.1053	10.7826
12/31/2019	15.1016	11.0135	12.6095	11.5723	11.0685	11.7266	10.9141	13.2903	12.8275	12.7929	11.9672	11.9620	12.3797	13.4947	12.5643	11.5981	11.7378	11.9047	10.1985	10.0962	10.7821
1/3/2020	15.1079	11.0459	12.6983	11.6392	11.1097	11.7483	10.9437	13.3650	12.8835	12.8495	12.0157	12.0270	12.4371	13.6041	12.6908	11.6195	11.7866	11.9711	10.2185	10.1290	10.7878



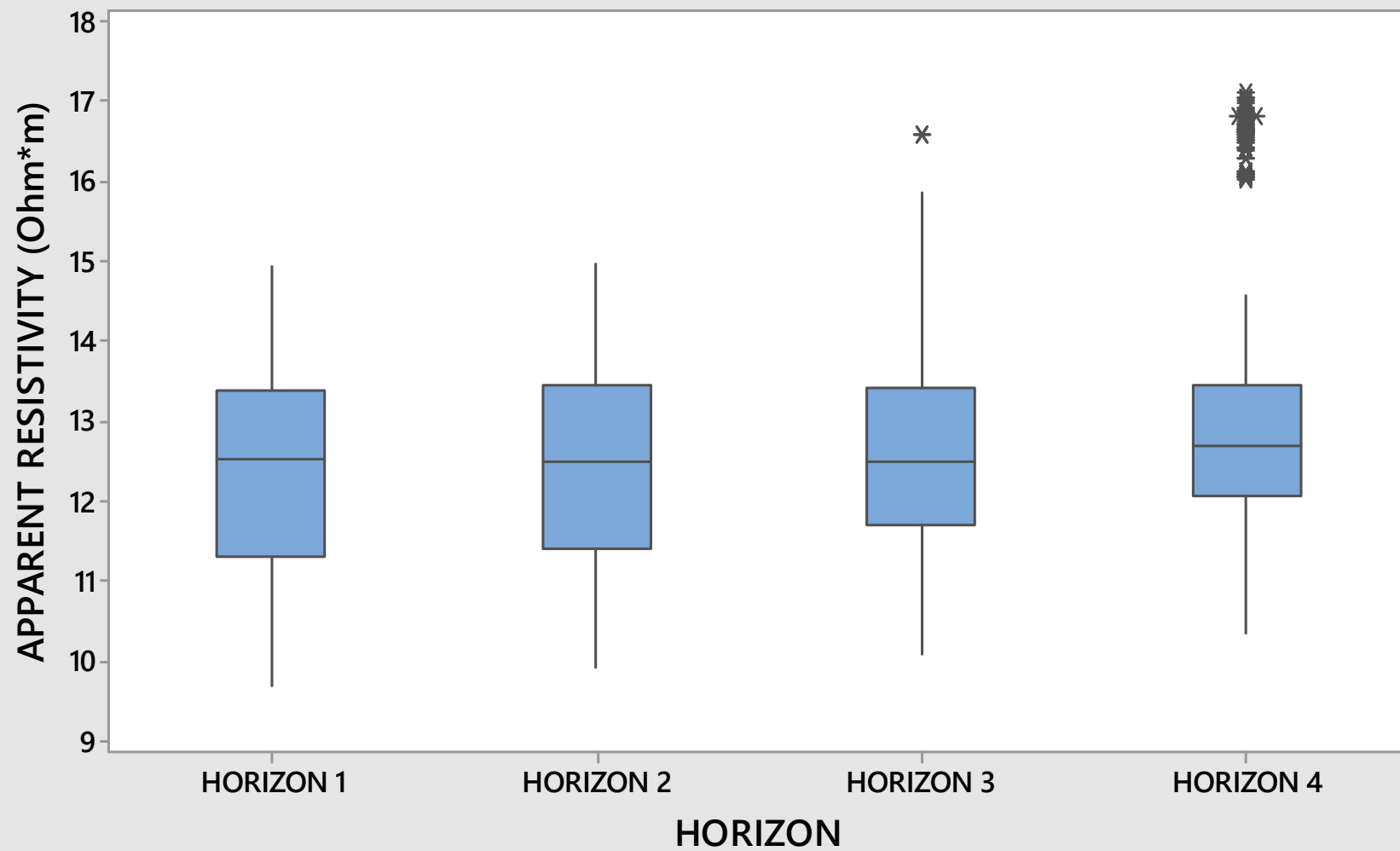
Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-03-BC2-04	B-03-BC2-04	B-03-BC2-04	B-03-BC2-04	B-04-BC-04	B-04-BC-04	B-04-BC-04	B-05-BC-04	B-05-BC-04	B-06-BC-04
Receiving Sensor	B-02-BC-04	B-03-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-03-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-06-BC-04	B-07-BC2-04	B-07-BC2-04
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 4																				
9/21/2018	16.8289	11.9274	13.3158	12.2804	11.6983	12.6071	12.3118	13.9299	13.4362	13.2792	12.4279	12.6599	13.0510	14.0422	13.1964	13.8120	12.5045	12.6661	10.9850	10.8837	13.3973
9/28/2018	16.9263	12.1484	13.5773	12.5338	11.9040	12.7342	12.4413	14.1974	13.6588	13.5702	12.6000	12.8536	13.2525	14.3711	13.4602	13.8777	12.7127	12.8890	11.1755	11.1180	13.4960
10/5/2018	16.8811	11.9276	13.2637	12.2407	11.6675	12.5709	12.2720	13.8873	13.3680	13.2723	12.4130	12.6637	13.0256	13.9870	13.1297	13.7808	12.5018	12.6057	10.9681	10.8867	13.4172
10/12/2018	16.9159	12.0471	13.4184	12.3543	11.8048	12.6397	12.3707	14.0513	13.5384	13.4352	12.4926	12.7475	13.1225	14.2167	13.2548	13.8359	12.6232	12.7543	11.0836	10.9757	13.4455
10/19/2018	16.8098	11.8221	13.1453	12.1202	11.5830	12.5004	12.2184	13.7463	13.2518	13.1537	12.3020	12.5548	12.8784	13.8992	13.0044	13.7739	12.3986	12.5178	10.9687	10.8005	13.3574
10/26/2018	16.8444	11.8664	13.1991	12.1644	11.6199	12.5056	12.2293	13.7928	13.2756	13.1825	12.3418	12.6022	12.9204	13.9468	13.0504	13.7501	12.4344	12.5514	11.0036	10.8383	13.3779
11/2/2018	16.8939	11.9836	13.3602	12.3056	11.7303	12.5896	12.3287	13.9518	13.4266	13.3349	12.4575	12.7017	13.0540	14.1078	13.1952	13.8204	12.5611	12.6929	11.0636	10.9344	13.4197
11/9/2018	16.9203	12.0587	13.4659	12.4057	11.8202	12.6695	12.3821	14.0556	13.5589	13.4536	12.5632	12.7808	13.1522	14.2320	13.2958	13.8811	12.6486	12.7936	11.1067	10.9711	13.4070
11/16/2018	17.0553	12.2280	13.6992	12.5854	12.0011	12.7690	12.5384	14.2898	13.8081	13.6776	12.7279	12.9867	13.3603	14.4895	13.5178	13.9754	12.8122	13.0140	11.2419	11.1434	13.5674
11/23/2018	17.1169	12.2619	13.7316	12.5986	12.0015	12.8036	12.5556	14.2948	13.7984	13.6475	12.7757	13.0042	13.3578	14.4787	13.5853	14.0003	12.8165	13.0718	11.2448	11.1891	13.6000
11/30/2018	17.0541	12.2444	13.6741	12.6005	11.9886	12.7750	12.5064	14.2992	13.7945	13.6825	12.7317	12.9694	13.3567	14.4818	13.5332	13.9221	12.8039	13.0019	11.2322	11.1767	13.5334
12/20/2018	17.0309	12.3192	13.8039	12.7048	12.0601	12.8098	12.5504	14.4199	13.9038	13.7989	12.7805	13.0451	13.4363	14.5779	13.6498	13.9680	12.9000	13.1020	11.2599	11.2370	13.5598
12/27/2018	16.9819	12.2403	13.7180	12.6179	11.9908	12.7459	12.4654	14.3239	13.8037	13.6978	12.7174	12.9452	13.3759	14.4996	13.5442	13.9394	12.8260	13.0116	11.2175	11.1852	13.5271
1/3/2019	16.9079	12.1150	13.5932	12.5125	11.8881	12.6797	12.3695	14.1850	13.6953	13.5827	12.5980	12.8547	13.2573	14.3476	13.4222	13.8817	12.7205	12.8830	11.1501	11.0880	13.4861
1/10/2019	16.7795	11.8789	13.2946	12.2242	11.6596	12.5079	12.1848	13.8839	13.3704	13.2656	12.3581	12.5913	12.9727	14.0239	13.1220	13.7683	12.4753	12.6234	10.9994	10.8613	13.3673
1/17/2019	16.7600	11.8581	13.2809	12.2231	11.6521	12.5020	12.1545	13.8584	13.3776	13.2503	12.3533	12.5821	12.9598	14.0188	13.1082	13.7755	12.4646	12.6033	10.9940	10.8661	13.3963
1/24/2019	16.8336	12.0069	13.2334	12.5229	11.9104	12.6682	12.1419	13.8396	13.2992	13.2031	12.5983	12.5319	13.2040	14.3314	13.0362	13.7901	12.5104	12.9708	11.1605	11.0149	13.3520
1/31/2019	16.8336	12.0069	13.2334	12.5229	11.9104	12.6682	12.1419	13.8396	13.2992	13.2031	12.5983	12.5319	13.2040	14.3314	13.0362	13.7901	12.5104	12.9708	11.1605	11.0149	13.3520
2/7/2019	16.6280	11.8395	13.3012	12.2368	11.6499	12.4848	12.1375	13.8742	13.3937	13.2597	12.3455	12.5708	12.9571	14.0161	13.1080	13.7542	12.4570	12.5988	10.9924	10.8595	13.3945
2/14/2019	16.7387	11.8543	13.3139	12.2436	11.6481	12.4736	12.1198	13.8905	13.3791	13.2611	12.3378	12.5536	12.9588	14.0083	13.1204	13.7322	12.4421	12.6011	10.9783	10.8516	13.3922
2/21/2019	16.7129	11.8586	13.3354	12.2476	11.6424	12.4824	12.1279	13.8979	13.4099	13.2612	12.3323	12.5753	12.9760	14.0485	13.1324	13.7502	12.4604	12.6275	10.9953	10.8581	13.3884
2/28/2019	16.6975	11.8130	13.2144	12.1505	11.5558	12.4165	12.0787	13.7875	13.2743	13.1490	12.2501	12.4849	12.8760	13.9219	13.0274	13.7001	12.3793	12.5014	10.9548	10.8136	13.3565
3/6/2019	16.6517	11.7295	13.1546	12.0733	11.5059	12.3897	12.0169	13.6910	13.1753	13.0750	12.2019	12.4137	12.7433	13.7808	12.9146	13.6490	12.2390	12.4126	10.7825	10.6552	13.3149
3/14/2019	16.6753	11.7883	13.2352	12.1276	11.5814	12.4405	12.0582	13.7905	13.2857	13.1559	12.3050	12.4683	12.8361	13.8965	13.0259	13.6652	12.3087	12.4934	10.8306	10.7529	13.3484
3/21/2019	16.6698	11.7783	13.2432	12.1942	11.5680	12.4215	12.0556	13.8114	13.3155	13.1934	12.2669	12.4760	12.8944	13.9291	13.0278	13.6732	12.3552	12.5159	10.8954	10.7907	13.3532
3/28/2019	16.6664	11.8012	13.2691	12.2051	11.5923	12.4240	12.0576	13.8398	13.3525	13.1981	12.2854	12.4860	12.8973	13.9495	13.0557	13.7022	12.3796	12.5366	10.9076	10.8016	13.3538
4/4/2019	16.7216	11.8746	13.3770	12.2902	11.6721	12.4747	12.0945	13.9371	13.4375	13.2950	12.3565	12.5599	12.9880	14.0565	13.1452	13.7060	12.4526	12.6175	10.9435	10.8698	13.3775
4/11/2019	16.5546	11.8379	13.4182	12.3348	11.7028	12.4511	12.0691	13.9465	13.4617	13.3124	12.3336	12.5209	12.9569	13.9757	13.1152	13.6923	12.3970	12.5988	10.9352	10.8178	13.3299
4/18/2019	16.6044	11.8555	13.4457	12.4729	11.7098	12.4601	12.0736	13.9472	13.4672	13.3058	12.3322	12.5059	12.9566	14.0089	13.1114	13.6702	12.4069	12.6149	10.9178	10.8439	13.3627
4/24/2019	16.6289	11.9859	13.5172	12.4740	11.8191	12.5333	12.1360	14.0750	13.6317	13.4295	12.4323	12.6206	13.0744	14.1576	13.2519	13.7042	12.4912	12.7321	11.0044	10.9463	13.4266
5/2/2019	16.6428	11.9786	13.5931	12.4788	11.8159	12.5334	12.1521	14.1128	13.5208	13.4485	12.4211	12.7159	13.1001	14.1763	13.2676	13.7273	12.4933	12.7434	11.0003	10.9578	13.4006
5/9/2019	16.6558	12.0201	13.6504	12.5613	11.8702	12.5541	12.1634	14.1571	13.6682	13.5039	12.4760	12.6828	13.1345	14.2176	13.3100	13.7504	12.5632	12.7908	11.0271	10.9070	13.3059
5/16/2019	16.6810	12.0815	13.7137	12.5889	11.8887	12.5661	12.1995	14.2251	13.7293	13.5238	12.4763	12.6949	13.1816	14.2473	13.3498	13.7516	12.6058	12.8474	11.0308	11.0175	13.4626
5/23/2019	16.6430	12.0655	13.7474	12.6146	11.9112	12.5822	12.1809	14.2691	13.7746	13.5748	12.5247	12.6991	13.1996	14.2836	13.3826	13.7319	12.6144	12.8574	11.0267	11.0097	13.4314
5/30/2019	16.6704	12.1153	13.8089	12.6658	11.9611	12.6022	12.2121	14.3144	13.8231	13.6283	12.5697	12.7642	13.2684	14.3665	13.4420	13.7724	12.6652	12.9366	11.0757	11.0785	13.4923
6/6/2019	16.6652	12.0771	13.7709	12.6202	11.9354	12.5875	12.1995	14.2702	13.7896	13.6054	12.5249	12.7348	13.2106	14.3372	13.4057	13.7467	12.6144	12.8962	11.0598	11.0567	13.4507
6/13/2019	16.6545	12.0582	13.7456	12.6106	11.9150	12.5642	12.1765	14.2462	13.7755	13.5586	12.5067	12.7042	13.1861	14.2888	13.3749	13.7384	12.5745	12.8701	11.0055	11.0316	13.4704
6/20/2019	16.6431	12.0853	13.8027	12.6568	11.9351	12.5774	12.1832	14.2902	13.7959	13.6068	12.5297	12.7300	13.2276	14.3381	13.4147	13.7129	12.6209	12.8997	11.0555	11.0580	13.4750
6/28/2019	16.7148	12.0987	13.8073	12.6683	11.9471	12.5948	12.1815	14.3081	13.8149	13.6261	12.5574	12.7402	13.2708	14.3618	13.4428	13.7376	12.6370	12.9176	11.0586	11.0470	13.4598

Sending Well	O-01	O-01	O-01	O-01	O-01	O-01	O-02	O-02	O-02	O-02	O-02	O-03	O-03	O-03	O-03	O-04	O-04	O-04	O-05	O-05	O-06
Receiving Well	O-02	O-03	O-04	O-05	O-06	O-07	O-03	O-04	O-05	O-06	O-07	O-04	O-05	O-06	O-07	O-05	O-06	O-07	O-06	O-07	O-07
Sending Sensor	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-01-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-02-BC-04	B-03-BC2-04	B-03-BC2-04	B-03-BC2-04	B-03-BC2-04	B-04-BC-04	B-04-BC-04	B-04-BC-04	B-05-BC-04	B-05-BC-04	B-06-BC-04
Receiving Sensor	B-02-BC-04	B-03-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-03-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-04-BC-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-05-BC-04	B-06-BC-04	B-07-BC2-04	B-06-BC-04	B-07-BC2-04	B-07-BC2-04
Apparent Resistivity ( $\Omega$ -m)																					
Date	Horizon 4																				
7/3/2019	16.6669	12.0660	13.7574	12.6251	11.8999	12.5906	12.1897	14.3006	13.7763	13.5787	12.5197	12.7270	13.2304	14.3288	13.4023	13.7416	12.6257	12.8895	11.0346	11.0448	13.4610
7/10/2019	16.6585	12.0628	13.7968	12.6534	11.9107	12.5629	12.1555	14.2821	13.7904	13.5728	12.5337	12.7123	13.2067	14.3199	13.3996	13.6994	12.6183	12.8977	11.0384	10.9279	13.3205
7/18/2019	16.6356	11.9730	13.6709	12.5379	11.8357	12.5107	12.0821	14.1646	13.6895	13.4508	12.4318	12.6133	13.1111	14.2162	13.2903	13.6773	12.5270	12.8108	10.9981	10.9609	13.3981
7/24/2019	16.6196	12.0932	13.8549	12.6880	11.9144	12.5959	12.1792	14.3391	13.8675	13.6407	12.5644	12.7408	13.2872	14.3851	13.4485	13.7041	12.6361	12.9513	11.0671	11.1011	13.4957
8/1/2019	16.5054	11.7662	13.3832	12.3007	11.6339	12.4095	11.9271	13.8856	13.4137	13.1912	12.2269	12.4099	12.8986	13.9014	13.0262	13.5550	12.3001	12.5596	10.8411	10.5665	13.0176
8/7/2019	16.6189	11.9450	13.6309	12.5052	11.7707	12.4934	12.0500	14.1155	13.6216	13.3989	12.3752	12.5626	13.0626	14.1088	13.2230	13.6153	12.4631	12.7072	10.9488	10.8087	13.2616
8/14/2019	16.5371	11.9229	13.6044	12.4790	11.7468	12.4687	12.0181	14.0462	13.6090	13.3923	12.3503	12.5228	13.0186	14.0926	13.1867	13.5662	12.4295	12.6580	10.9200	10.8943	13.3545
8/22/2019	16.5941	11.9416	13.6424	12.6575	11.8066	12.4925	12.0575	14.1269	13.6496	13.4249	12.4142	12.5308	13.0746	14.1630	13.2711	13.5601	12.4560	12.7371	10.9373	10.9190	13.3781
8/29/2019	16.6082	11.9706	13.6553	12.5397	11.8110	12.4929	12.0390	14.1347	13.6739	13.4350	12.4103	12.5435	13.0763	14.1567	13.2397	13.5996	12.5508	12.7294	10.8949	10.8730	13.3271
9/4/2019	16.5935	11.9618	13.6482	12.5288	11.8228	12.4996	12.0323	14.1535	13.6176	13.4500	12.3844	12.5659	12.9943	14.1703	13.2751	13.5590	12.4628	12.7671	10.9220	10.9300	13.3873
9/11/2019	16.5103	11.9596	13.6979	12.5792	11.8447	12.5048	12.0541	14.1998	13.7084	13.4546	12.3914	12.5509	13.1150	14.1833	13.2724	13.5741	12.4668	12.7453	10.9207	10.9382	13.3961
9/18/2019	16.5566	11.9852	13.7323	12.5838	11.8304	12.4949	12.0417	14.1955	13.7207	13.4856	12.4099	12.5616	13.1161	14.1867	13.2964	13.5537	12.4909	12.7835	10.9474	10.8885	13.2939
9/25/2019	16.5244	11.9715	13.7073	12.5714	11.8285	12.4929	12.0201	14.1924	13.7042	13.4733	12.4136	12.5763	13.1167	14.1980	13.2807	13.5474	12.4768	12.7735	10.9328	10.9336	13.3992
10/4/2019	16.4385	11.8078	13.4824	12.3807	11.6479	12.3919	11.8886	13.9992	13.5310	13.2661	12.2431	12.4525	12.9691	13.9916	13.1035	13.4918	12.3339	12.6057	10.8443	10.8259	13.3422
10/11/2019	16.4153	11.8265	13.5270	12.4197	11.6758	12.3925	11.8978	14.0029	13.5341	13.2739	12.2553	12.4420	12.9830	14.0118	13.1178	13.4371	12.3485	12.6184	10.8391	10.8243	13.3451
10/18/2019	16.4290	11.8429	13.5396	12.4289	11.7115	12.4088	11.9050	14.0214	13.5677	13.3269	12.2806	12.4698	13.0158	14.0677	13.1648	13.4810	12.3620	12.6492	10.8773	10.8726	13.3812
10/24/2019	16.4248	11.8771	13.6025	12.4717	11.7137	12.4065	11.9014	14.0799	13.6157	13.3422	12.3017	12.5405	13.0602	14.1011	13.1757	13.5236	12.4071	12.6900	10.8985	10.8867	13.3840
11/1/2019	16.4006	11.9134	13.6042	12.4527	11.7172	12.4146	11.9254	14.0897	13.5925	13.3173	12.2910	12.5482	13.0799	14.0912	13.1958	13.5414	12.4223	12.7017	10.9016	10.9182	13.3941
11/8/2019	16.2901	11.7547	13.4546	12.3612	11.6451	12.3497	11.7895	13.9186	13.4560	13.2038	12.1779	12.4073	12.9220	13.9159	13.0362	13.5015	12.2988	12.5423	10.8216	10.7963	13.3105
11/14/2019	16.3025	11.7656	13.4887	12.3618	11.6490	12.3580	11.8101	13.9240	13.4805	13.2321	12.1984	12.4390	12.9441	13.9581	13.0693	13.5225	12.3296	12.5797	10.8516	10.8217	13.3402
11/21/2019	16.1235	11.3864	13.0027	11.9352	11.2849	12.1166	11.5326	13.4399	12.9578	12.7151	11.8044	12.0381	12.4909	13.4225	12.5823	13.3552	11.9658	12.1589	10.6207	10.4711	13.1616
11/26/2019	16.1039	11.2352	13.0004	11.9422	11.2905	12.1229	11.2154	13.4078	12.9760	12.7321	11.8117	11.9161	12.4319	13.4022	12.5546	13.3393	11.9736	12.1653	10.6096	10.4701	13.1658
12/3/2019	16.0496	11.2975	12.8800	11.8077	11.1954	12.0552	11.4581	13.3191	12.8700	12.6219	11.7471	11.9368	12.3788	13.3188	12.4622	13.2894	11.8694	12.0610	10.5688	10.4006	13.1360
12/4/2019	16.0400	11.2477	12.8370	11.7992	11.1558	12.0430	11.4450	13.3005	12.8562	12.6106	11.7184	11.9320	12.3699	13.3069	12.4611	13.2829	11.8553	12.0517	10.5586	10.3905	13.1083
12/5/2019	16.0772	11.2457	12.8050	11.7609	11.1423	12.0538	11.4394	13.2784	12.8309	12.5828	11.7061	11.9105	12.3589	13.2746	12.4385	13.2752	11.8528	12.0302	10.5347	10.3823	13.1175
12/11/2019	16.1344	11.3311	12.9546	11.8806	11.2340	12.1011	11.4051	13.4062	12.9318	12.6711	11.7806	11.9195	12.3816	13.3113	12.4782	13.2876	11.9276	12.1287	10.5960	10.4568	13.1591
12/19/2019	16.0923	11.3561	12.9274	11.8832	11.2406	12.0945	11.4874	13.3889	12.9088	12.6860	11.7973	12.0038	12.4448	13.3744	12.5525	13.2738	11.9871	12.1335	10.5954	10.4202	13.1627
12/20/2019	16.1117	11.3818	12.9895	11.9178	11.2677	12.1204	11.5283	13.4406	12.9820	12.7195	11.8051	12.0259	12.4860	13.4209	12.5808	13.3077	11.9349	12.1435	10.5968	10.4715	13.1634
12/21/2019	16.1129	11.4030	13.0062	11.9410	11.2868	12.1367	11.5304	13.4666	13.0034	12.7526	11.8302	12.0446	12.5098	13.4532	12.6139	13.3180	11.9703	12.1740	10.6128	10.4901	13.1567
12/23/2019	16.1142	11.3798	12.9668	11.9083	11.2520	12.1124	11.5183	13.4335	12.9786	12.7157	11.8025	12.0250	12.4812	13.4068	12.6072	13.3044	11.9379	12.1485	10.5912	10.4697	13.1592
12/28/2019	16.0509	11.2286	12.7925	11.7417	11.1196	12.0259	11.4104	13.2300	12.7783	12.5215	11.6543	11.8707	12.3081	13.2214	12.3823	13.2322	11.7951	11.9576	10.5128	10.3312	13.1021
12/30/2019	16.0489	11.2738	12.8492	11.7873	11.1537	12.0549	11.4460	13.2960	12.8306	12.5907	11.7006	11.9026	12.3504	13.2707	12.4540	13.2505	11.8264	12.0286	10.5435	10.3792	13.1196
12/31/2019	16.0542	11.2659	12.8377	11.7666	11.1537	12.0491	11.4348	13.2877	12.8267	12.6273	11.6977	11.9026	12.3548	13.2690	12.4339	13.2500	11.8367	12.0147	10.5316	10.3734	13.1157
1/3/2020	16.0636	11.2963	12.9068	11.8368	11.1998	12.0819	11.4690	13.3574	12.9041	12.6437	11.7472	11.9638	12.4047	13.3465	12.4988	13.2560	11.9020	12.0833	10.5682	10.4143	13.1380

## **ATTACHMENT 4**

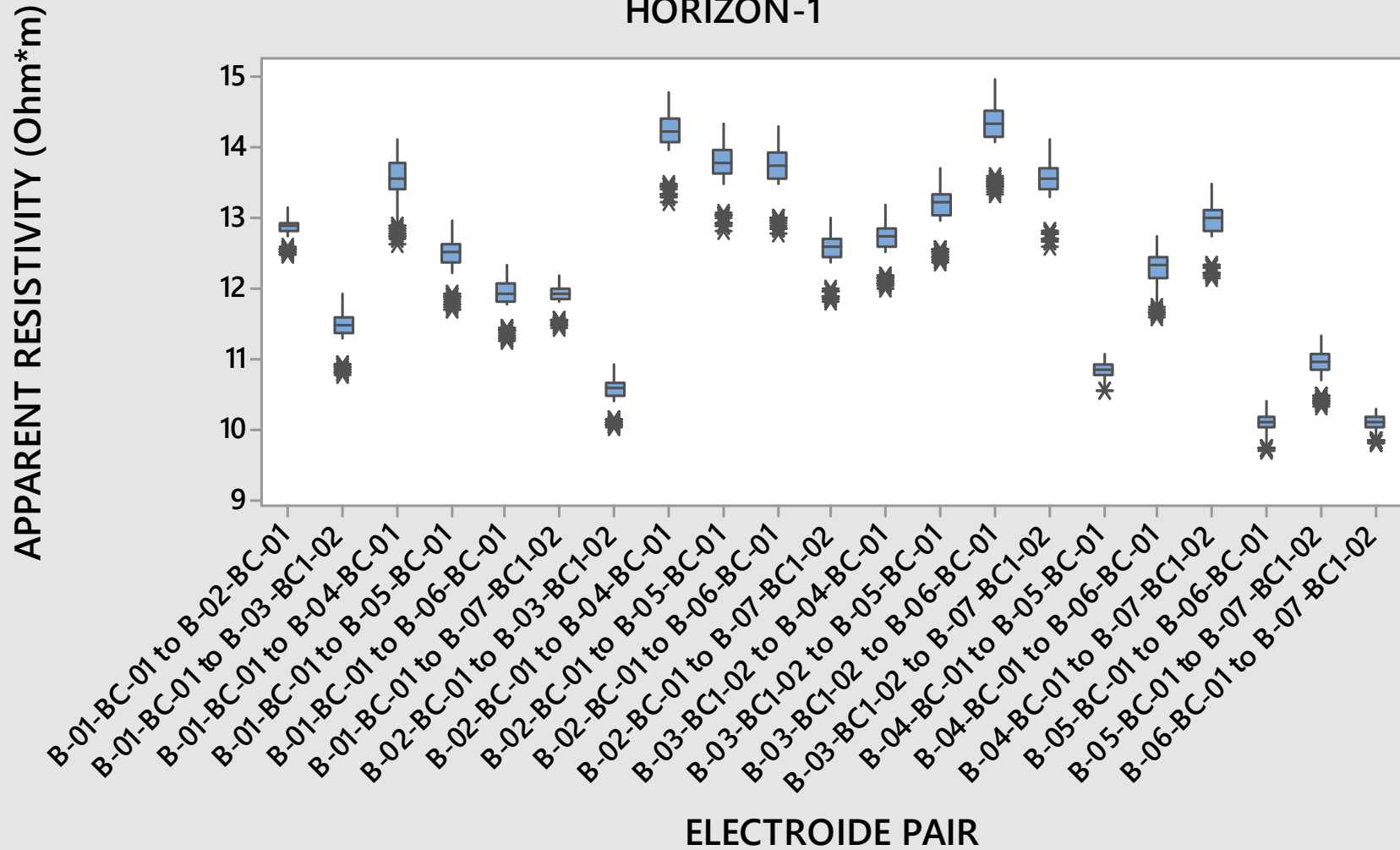
### **Exploratory Analysis Plots**

Boxplot of APPARENT RESISTIVITY (Ohm\*m)



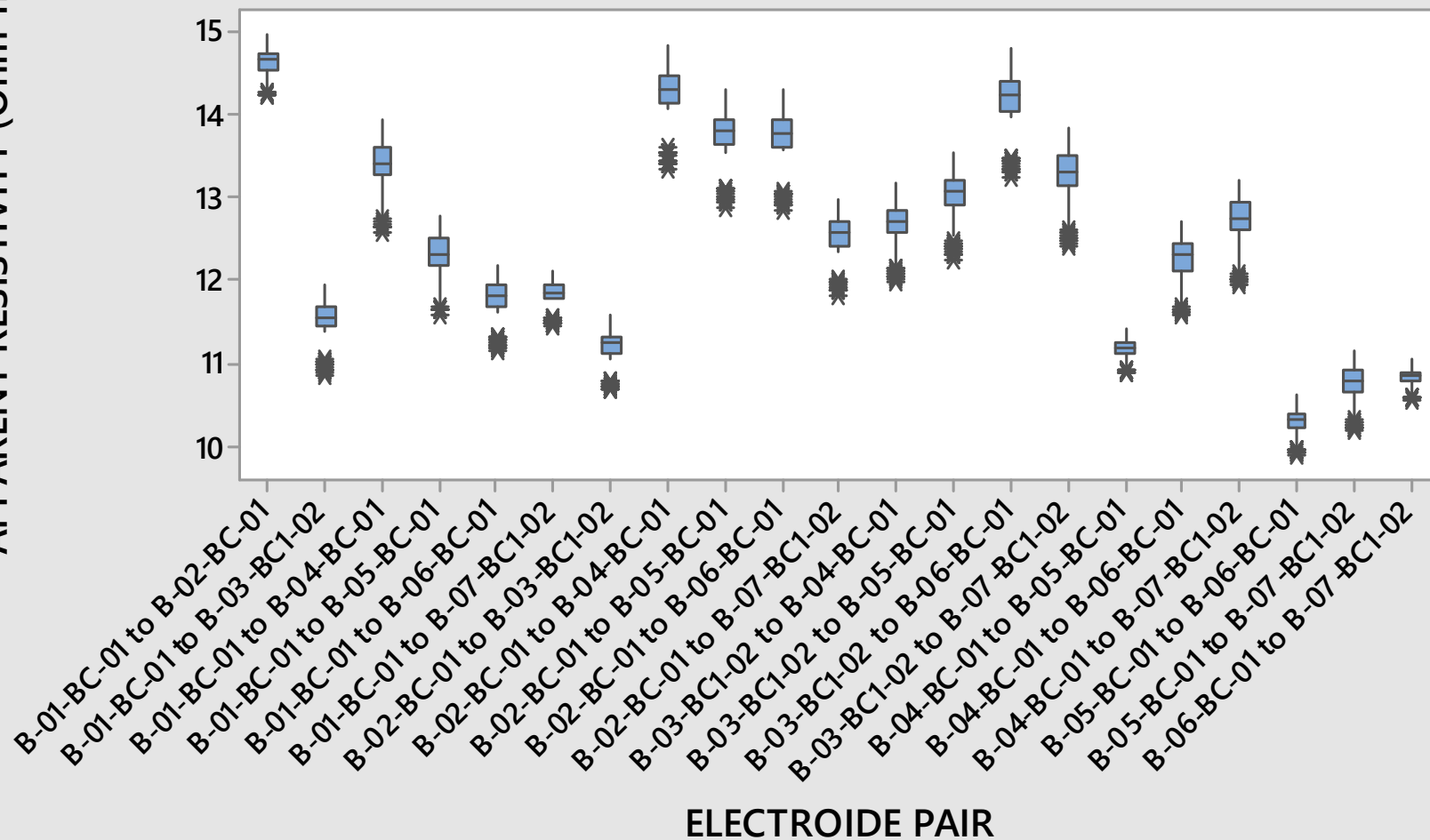


Boxplot of APPARENT RESISTIVITY (Ohm\*m)  
HORIZON-1



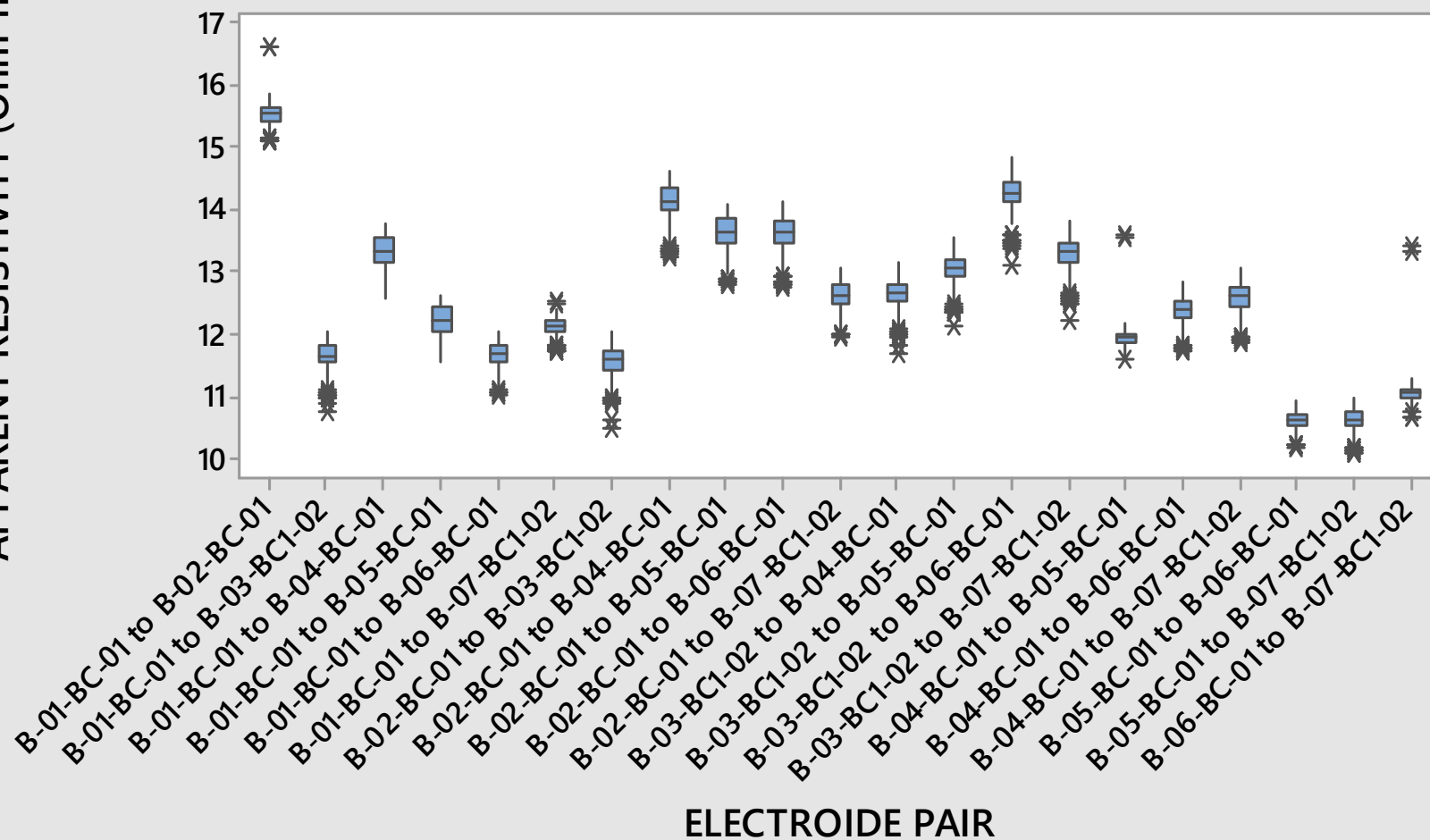
# Boxplot of APPARENT RESISTIVITY (Ohm\*m) HORIZON-2

APPARENT RESISTIVITY (Ohm\*m)\_1



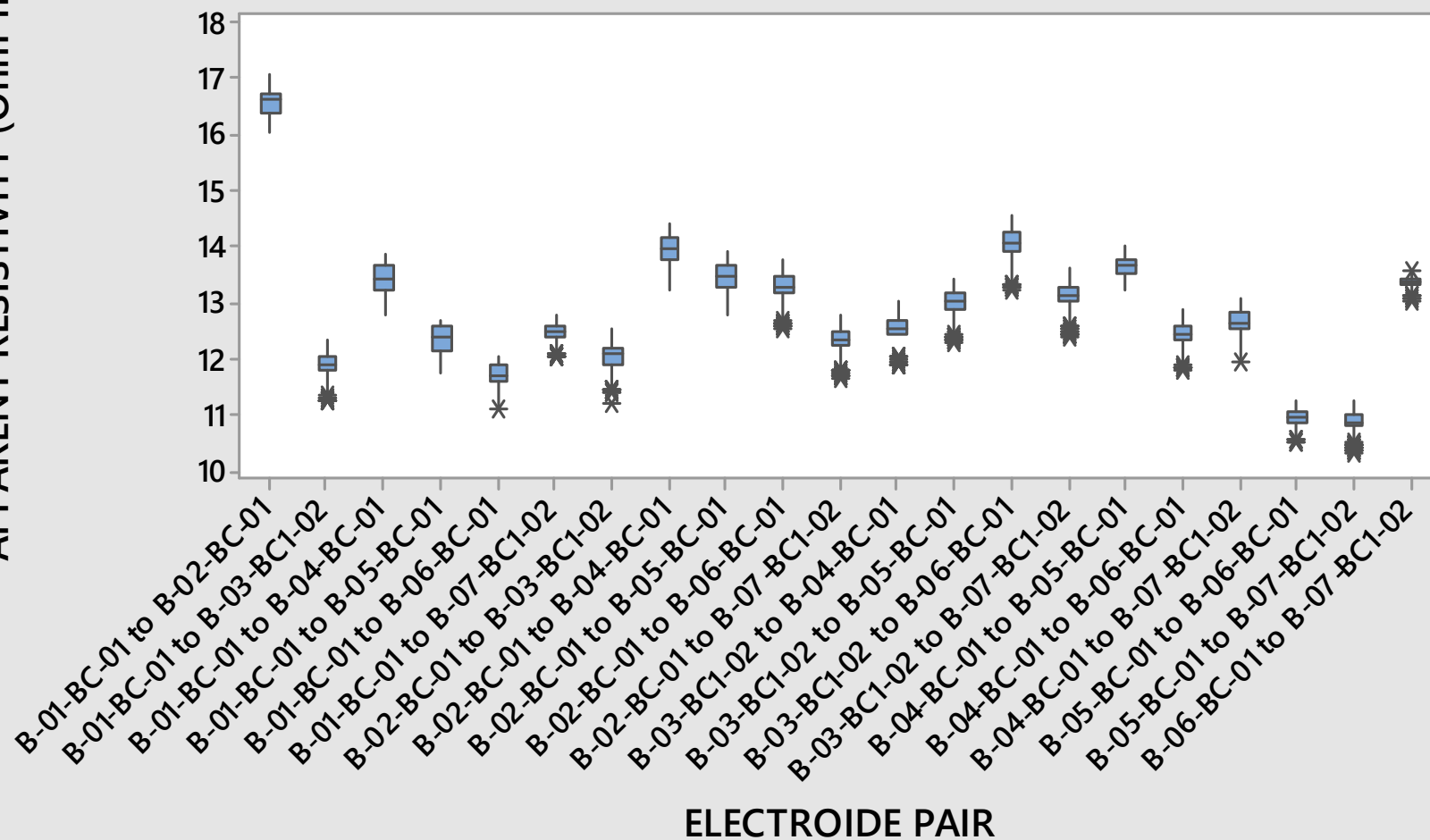
# Boxplot of APPARENT RESISTIVITY (Ohm\*m) HORIZON-3

APPARENT RESISTIVITY (Ohm\*m)\_2



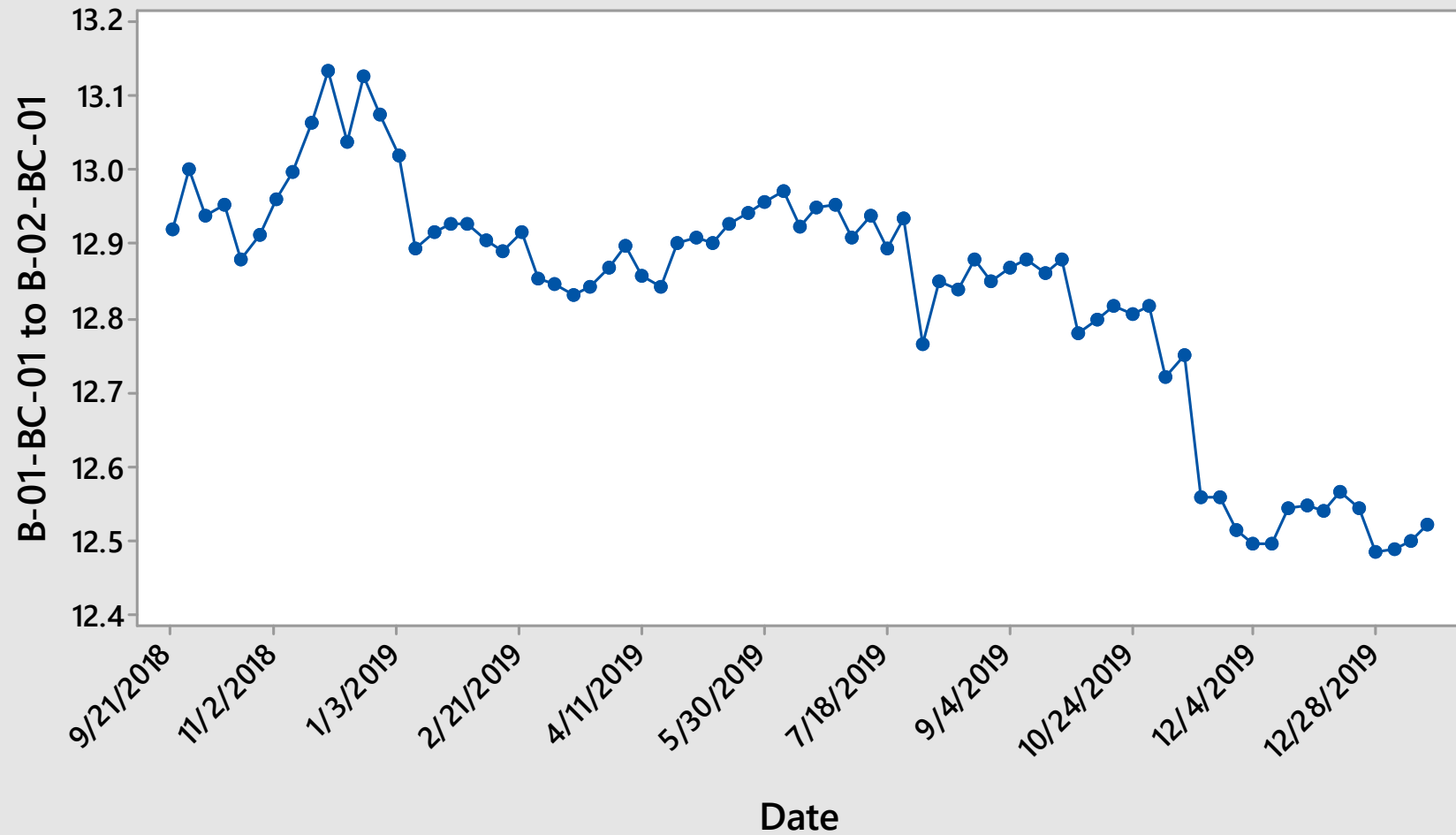
Boxplot of APPARENT RESISTIVITY (Ohm\*m)  
HORIZON-4

APPARENT RESISTIVITY (Ohm\*m)\_3

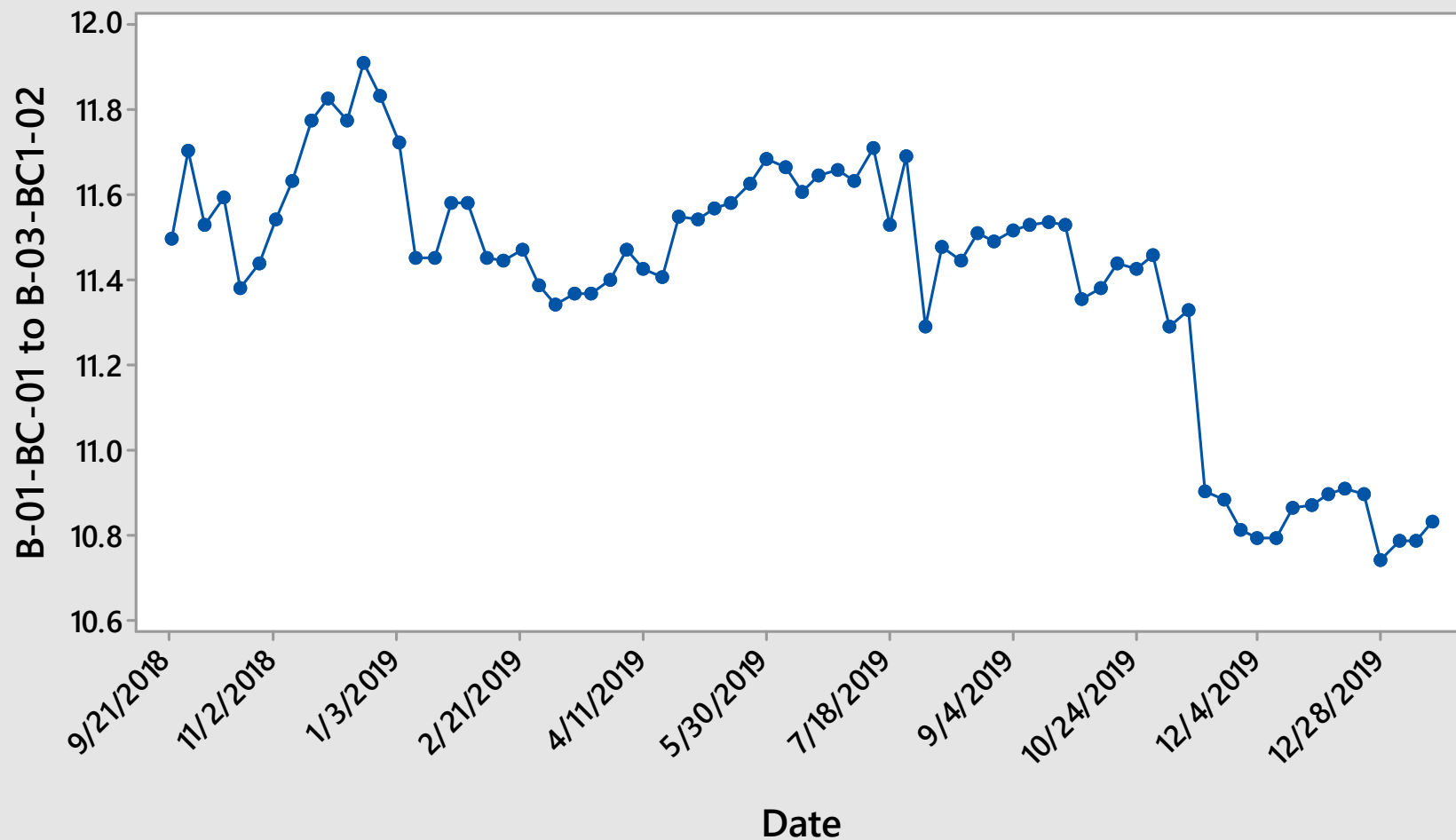




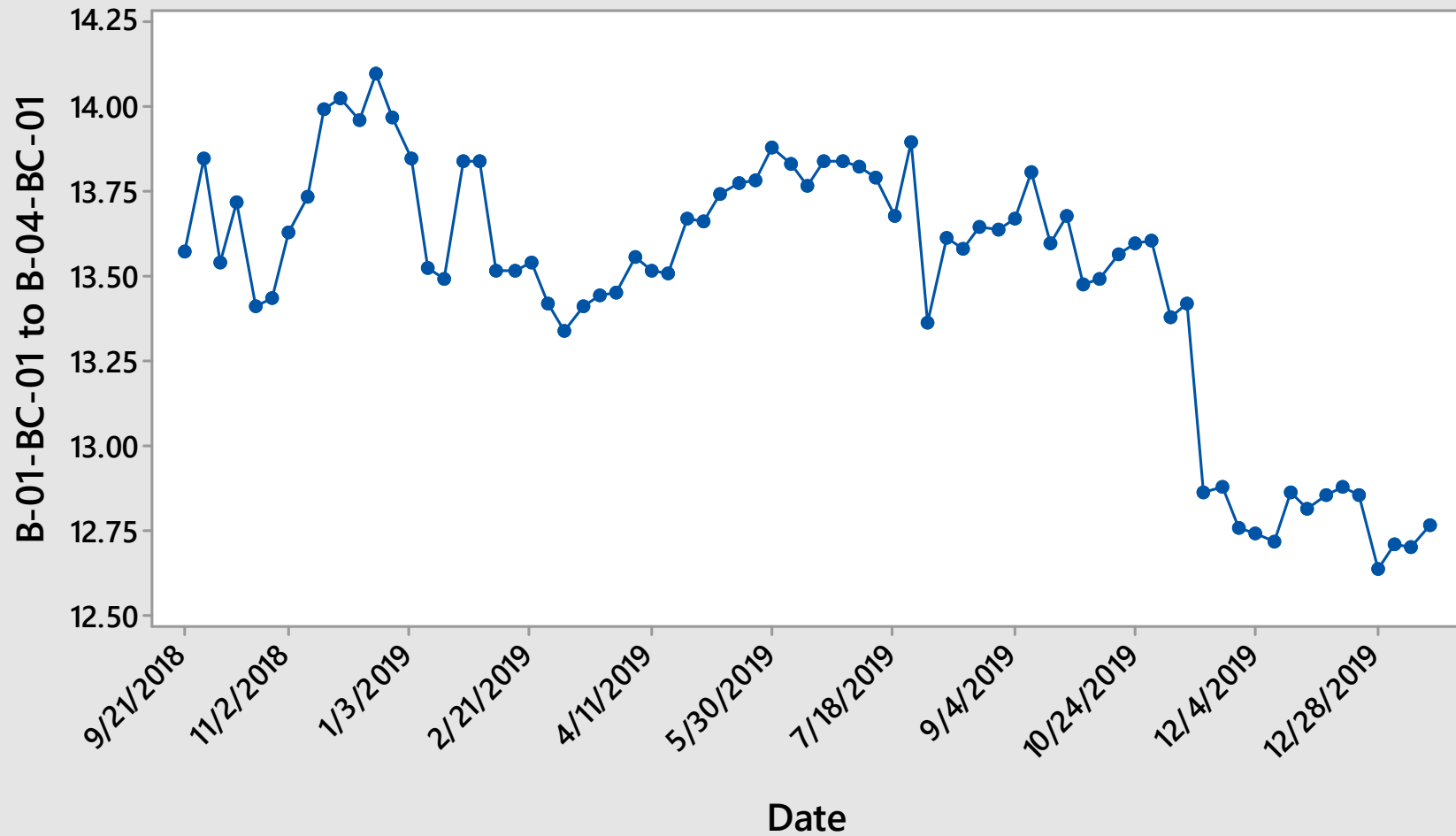
Time Series Plot of B-01-BC-01 to B-02-BC-01  
HORIZON-1



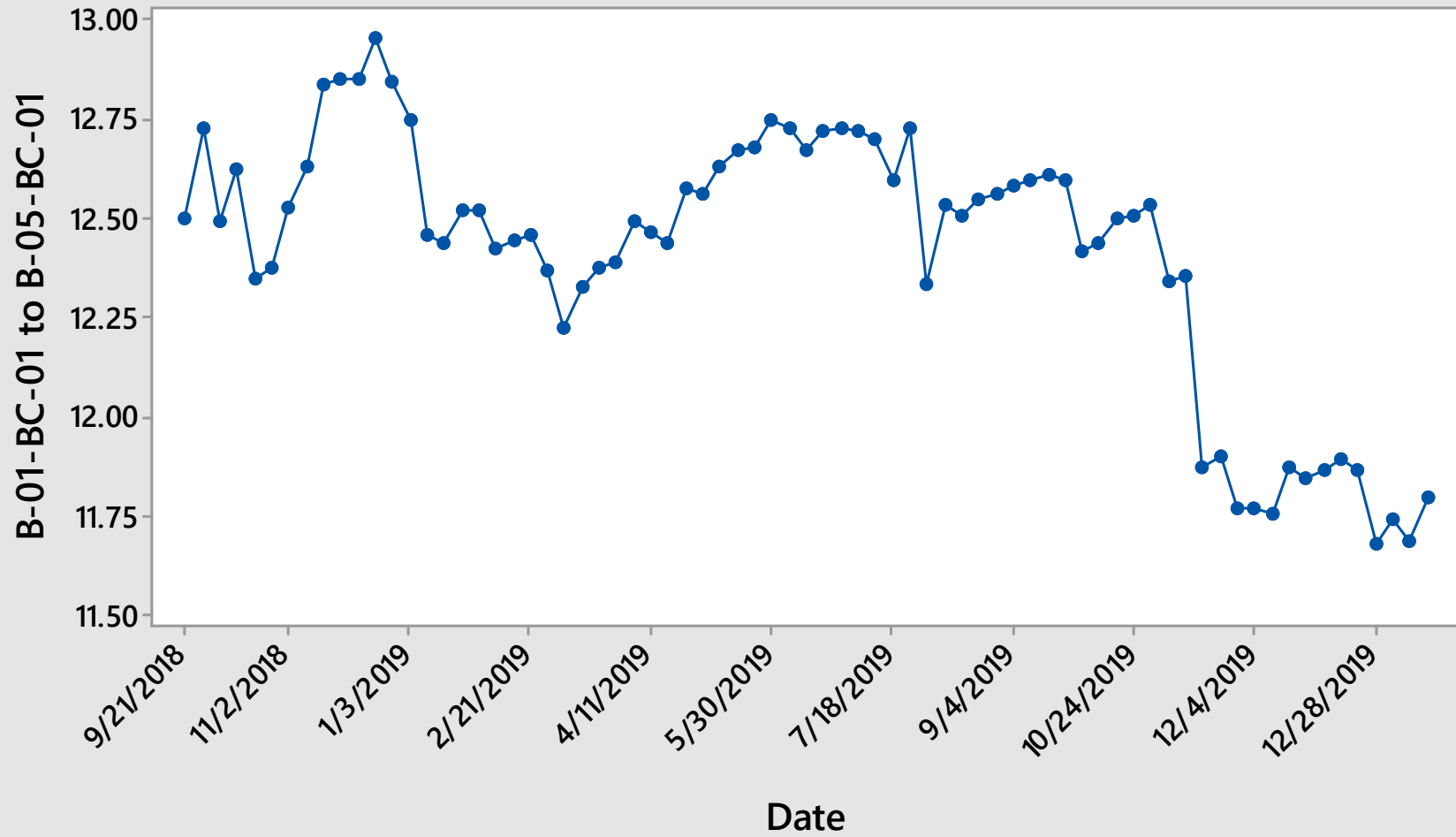
Time Series Plot of B-01-BC-01 to B-03-BC1-02  
HORIZON-1



Time Series Plot of B-01-BC-01 to B-04-BC-01  
HORIZON-1

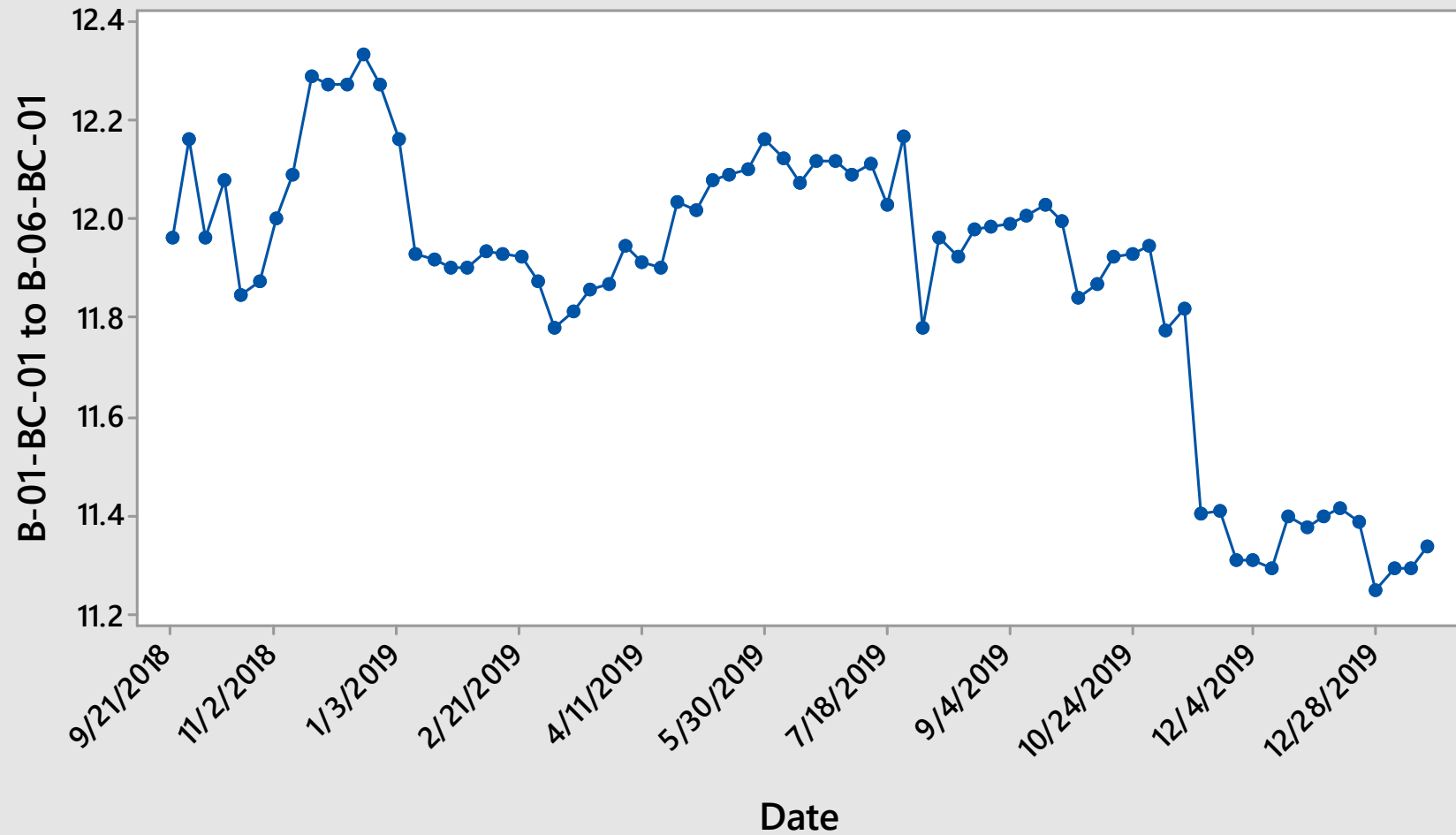


Time Series Plot of B-01-BC-01 to B-05-BC-01  
HORIZON-1

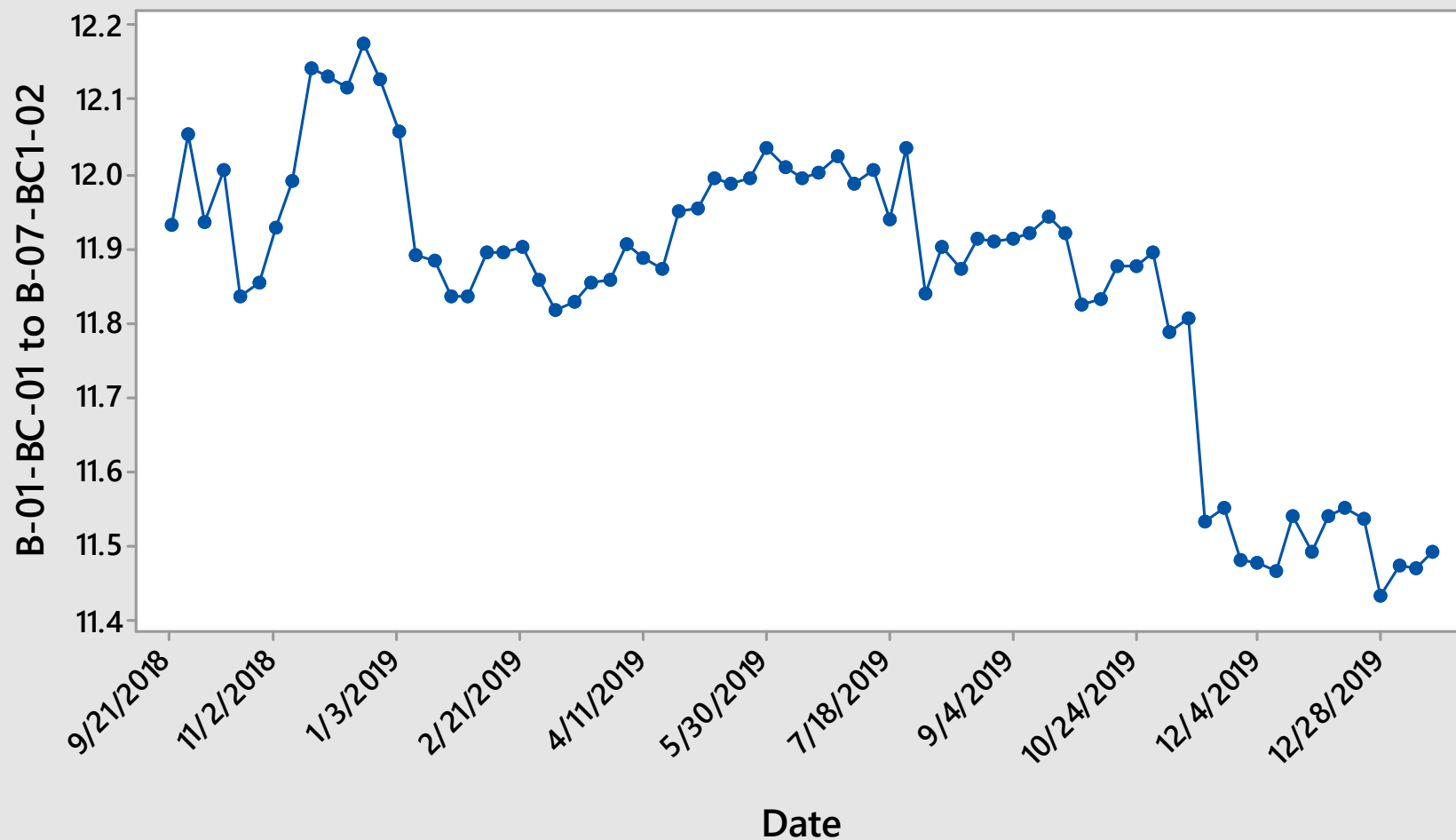




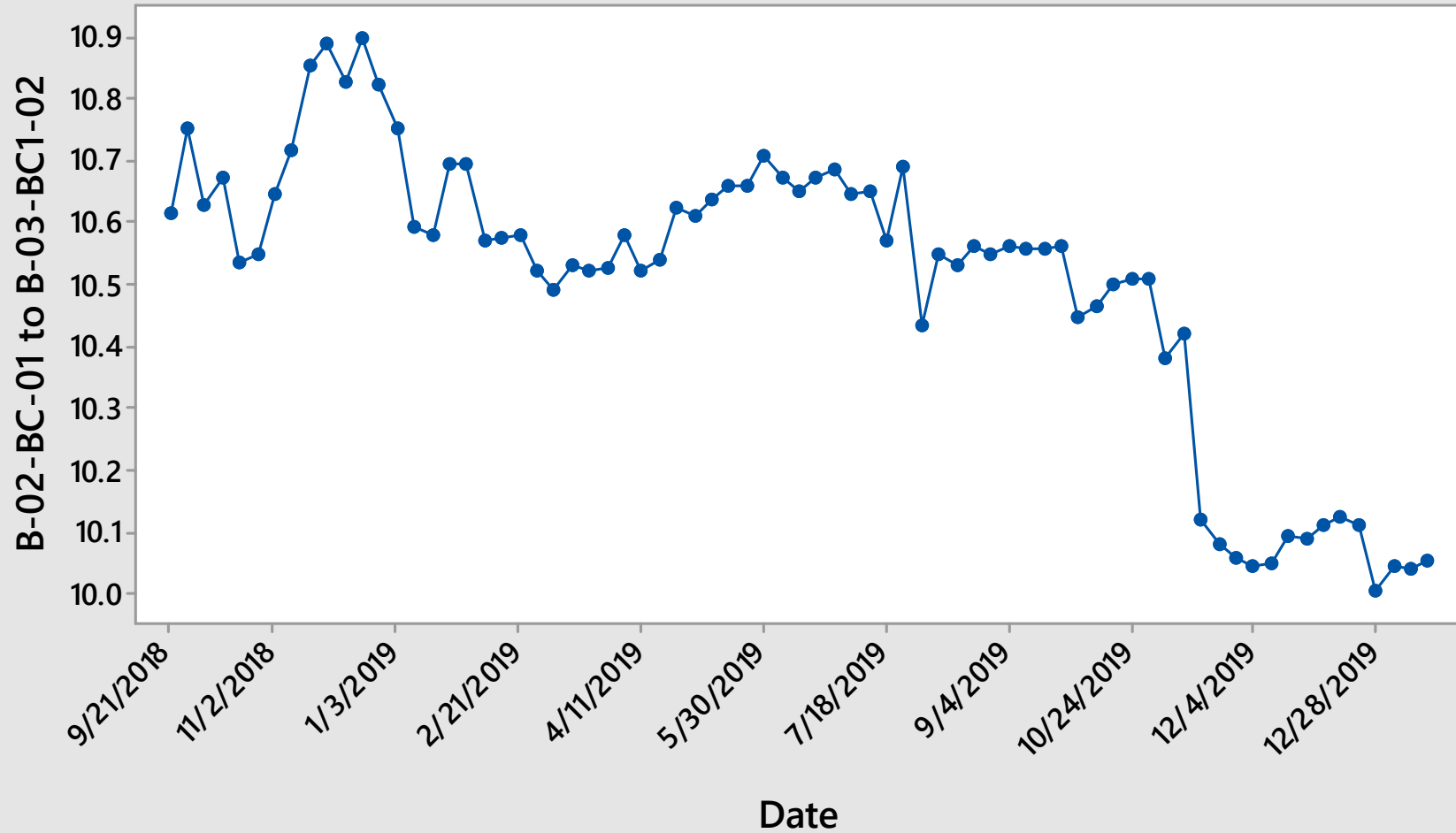
Time Series Plot of B-01-BC-01 to B-06-BC-01  
HORIZON-1



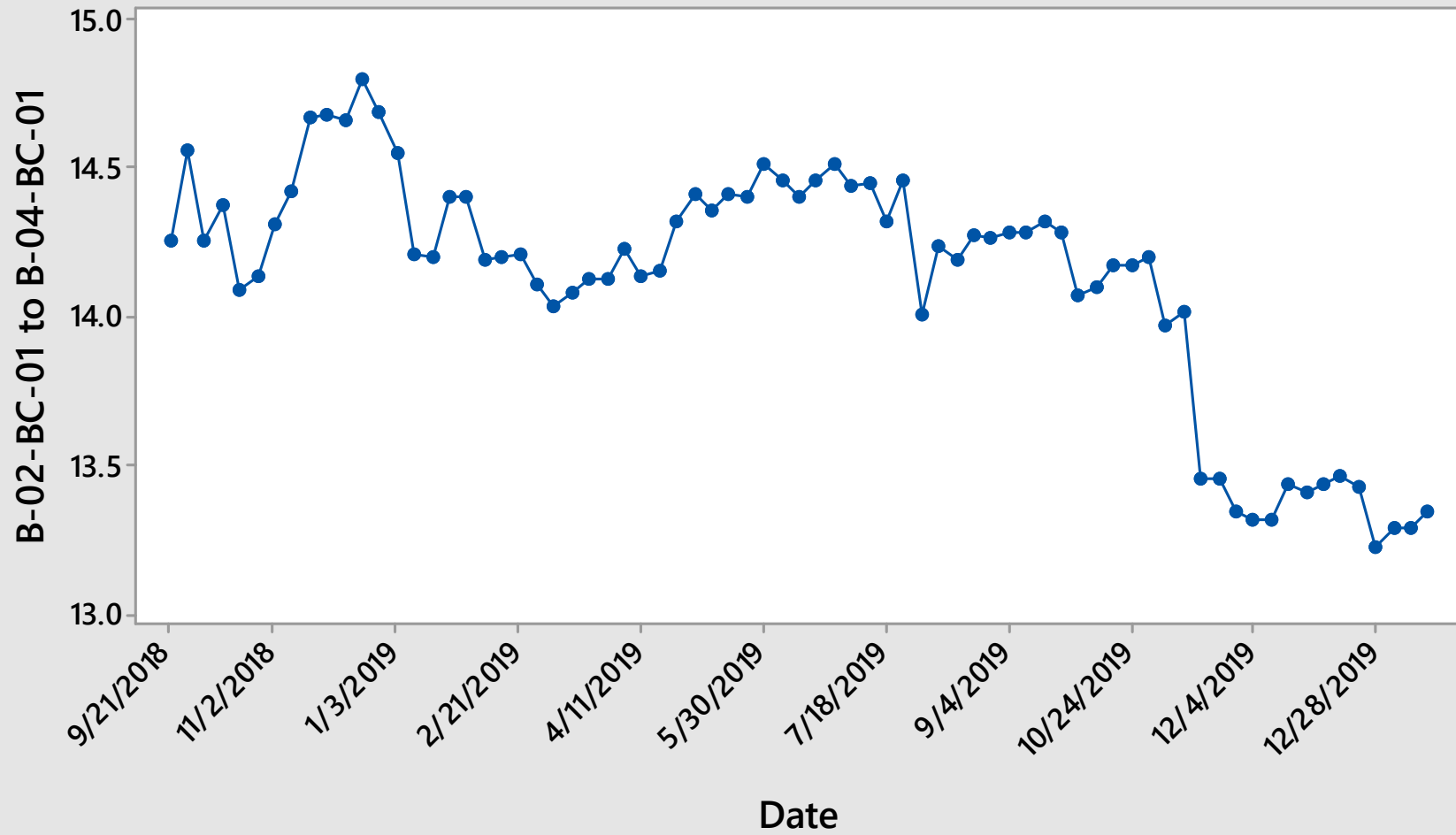
Time Series Plot of B-01-BC-01 to B-07-BC1-02  
HORIZON-1



Time Series Plot of B-02-BC-01 to B-03-BC1-02  
HORIZON-1

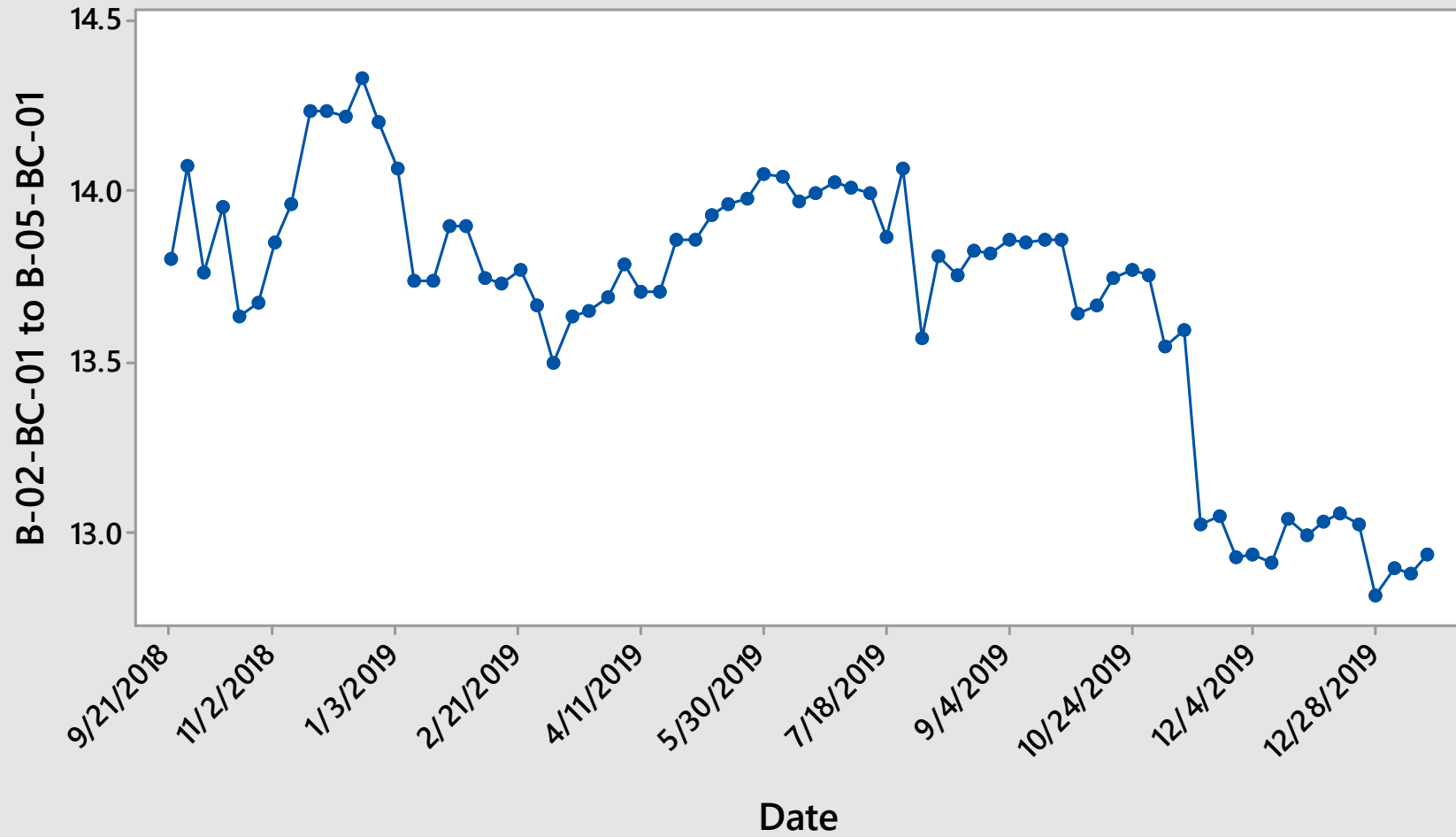


Time Series Plot of B-02-BC-01 to B-04-BC-01  
HORIZON-1

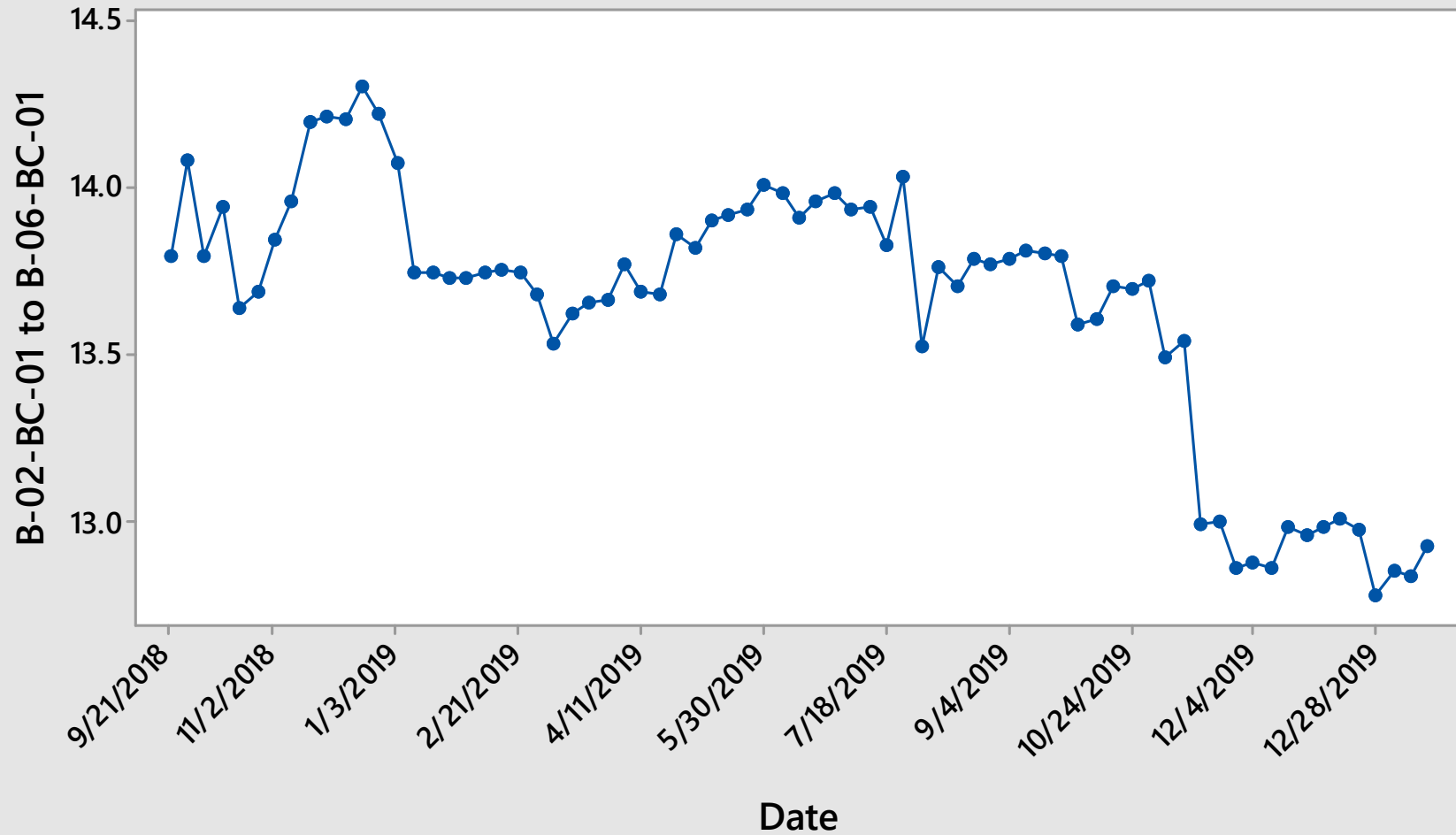




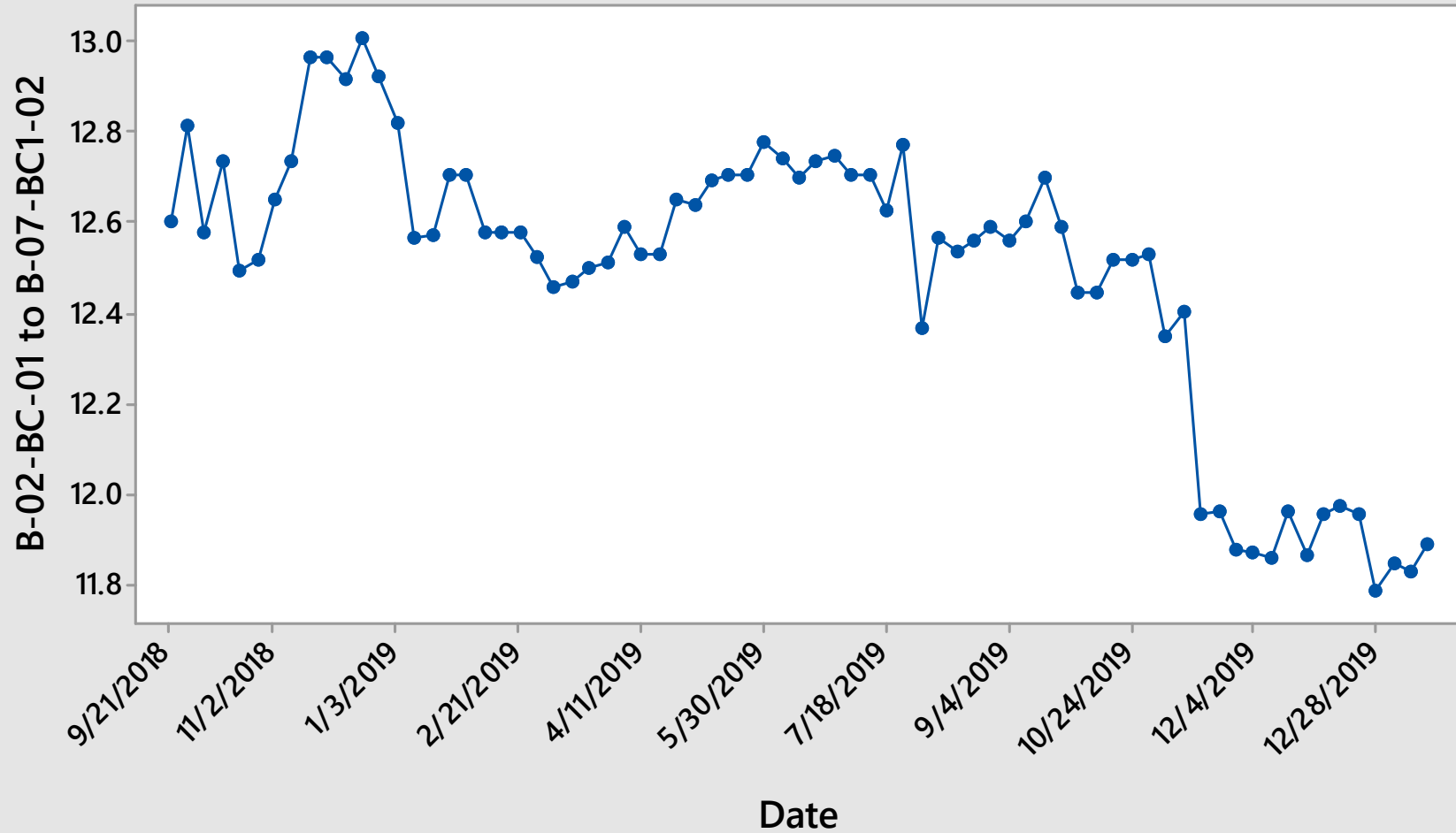
Time Series Plot of B-02-BC-01 to B-05-BC-01  
HORIZON-1



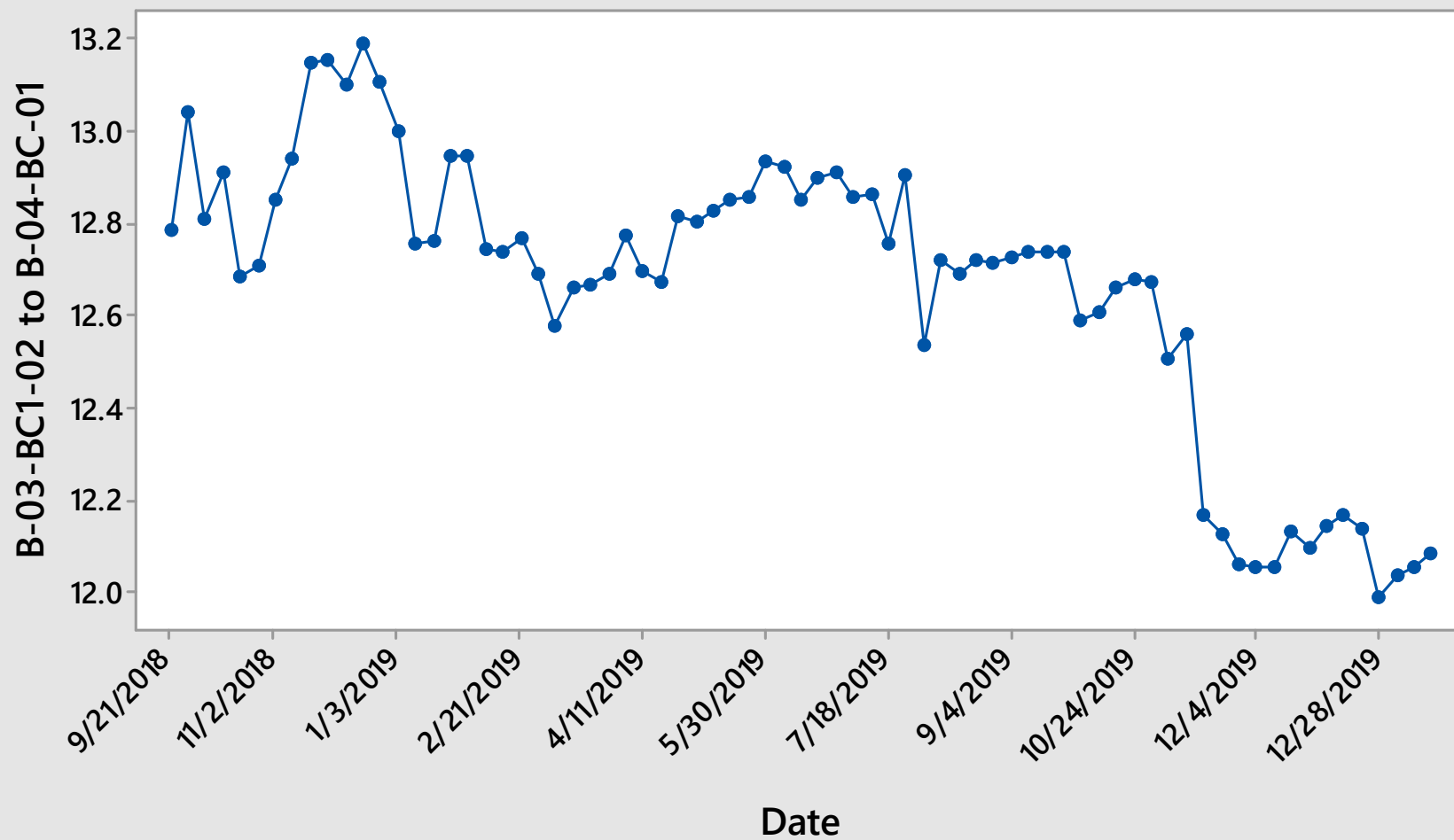
Time Series Plot of B-02-BC-01 to B-06-BC-01  
HORIZON-1



Time Series Plot of B-02-BC-01 to B-07-BC1-02  
HORIZON-1

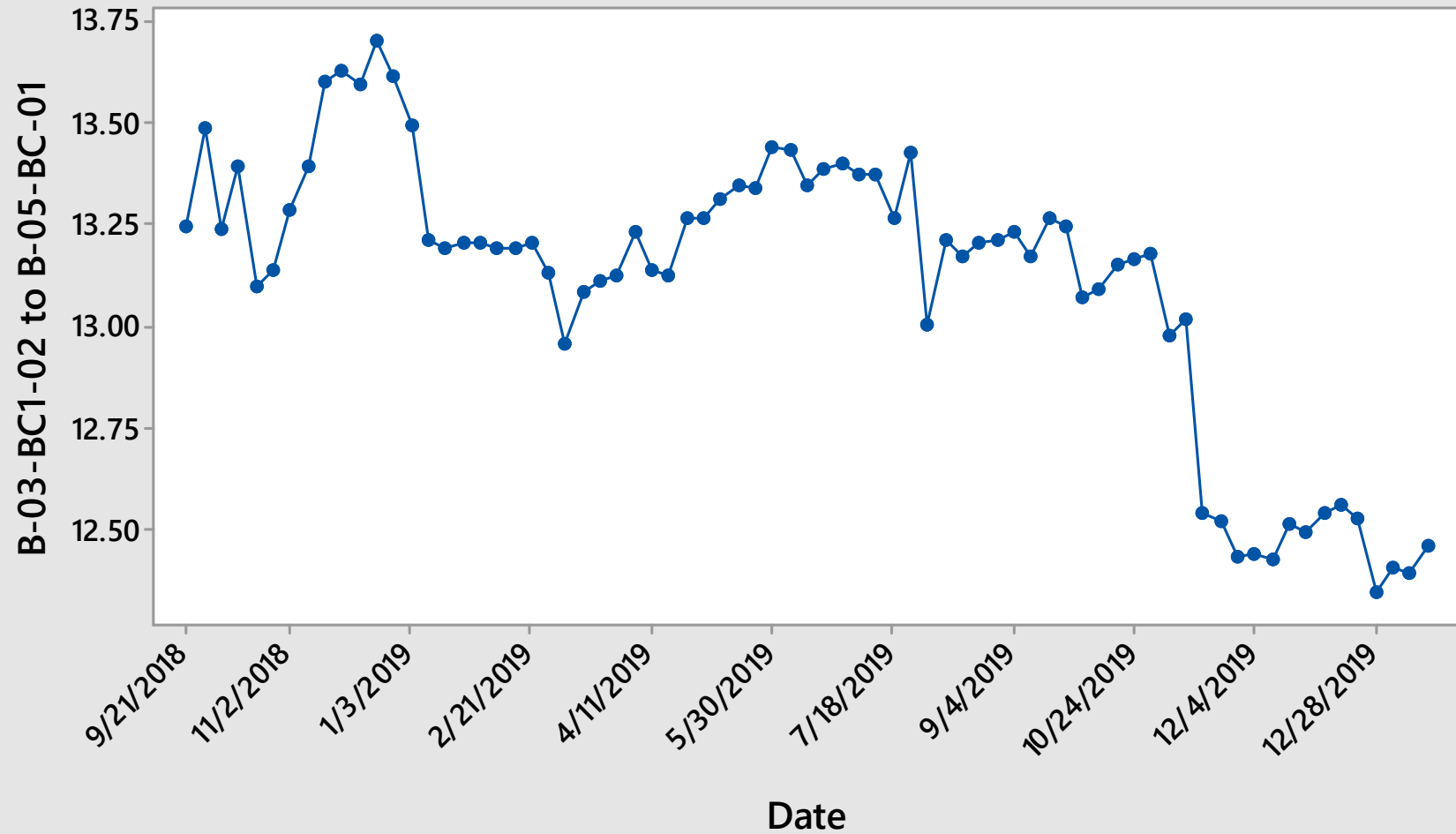


Time Series Plot of B-03-BC1-02 to B-04-BC-01  
HORIZON-1

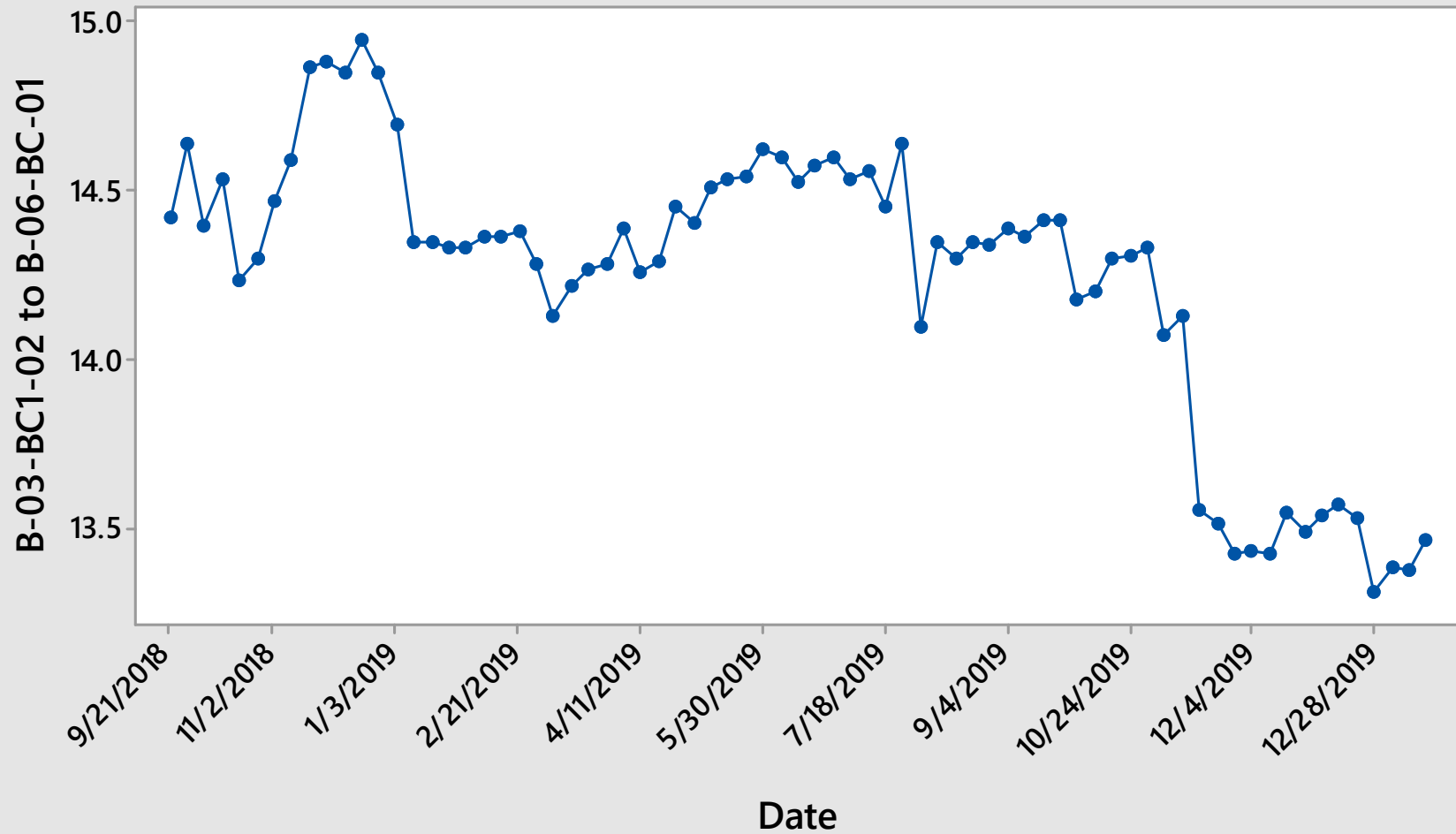




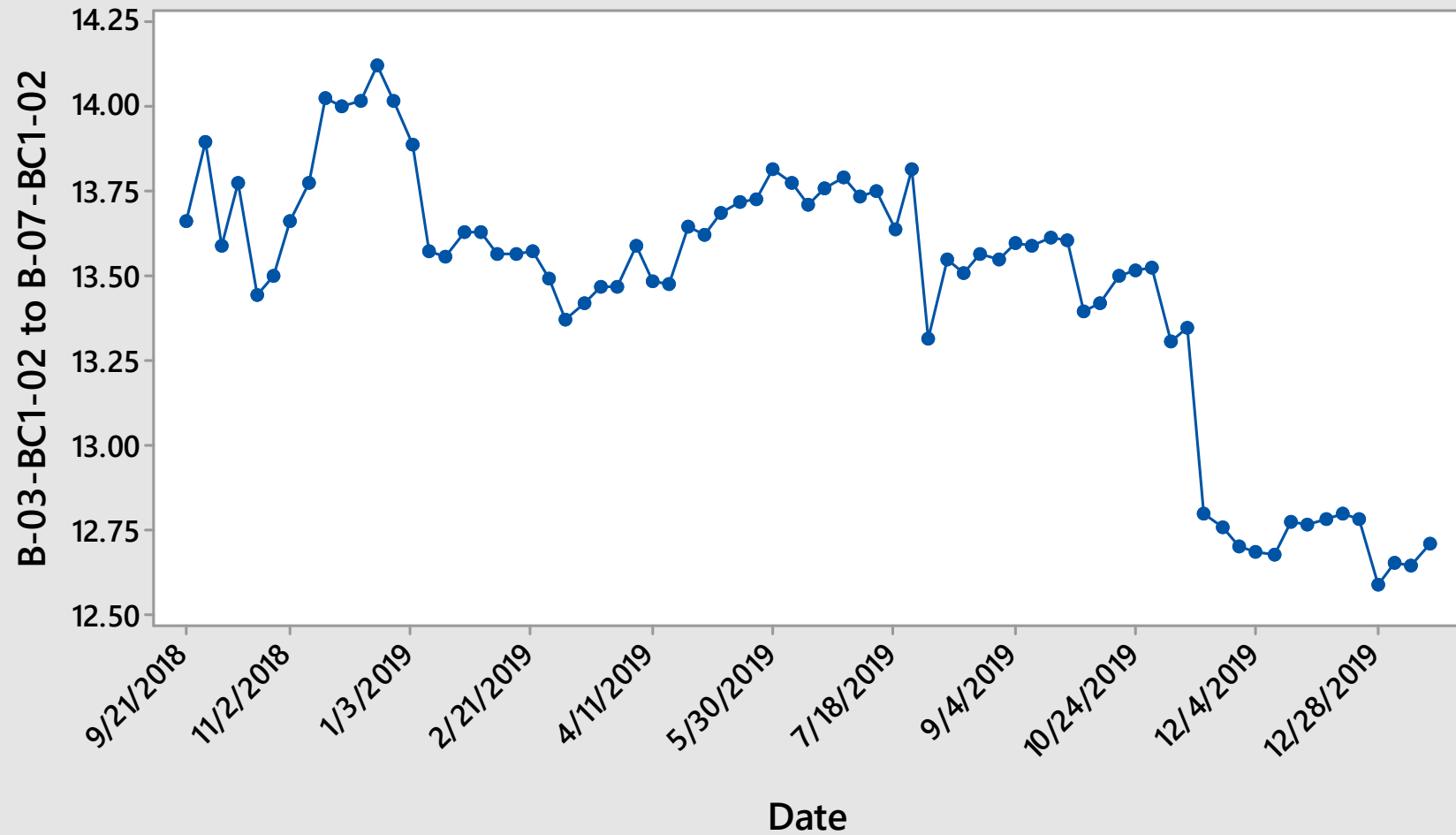
Time Series Plot of B-03-BC1-02 to B-05-BC-01  
HORIZON-1



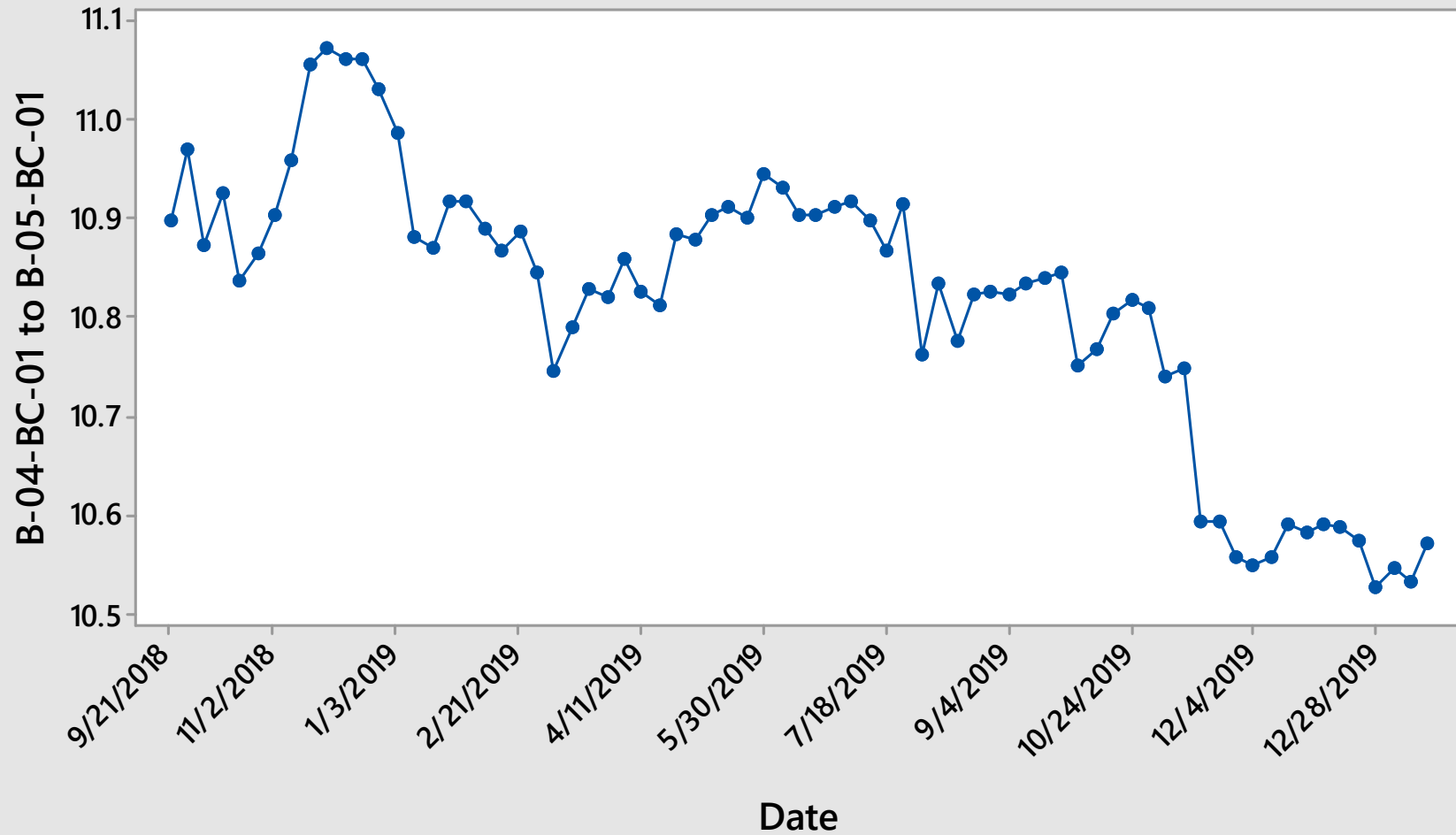
Time Series Plot of B-03-BC1-02 to B-06-BC-01  
HORIZON-1



Time Series Plot of B-03-BC1-02 to B-07-BC1-02  
HORIZON-1

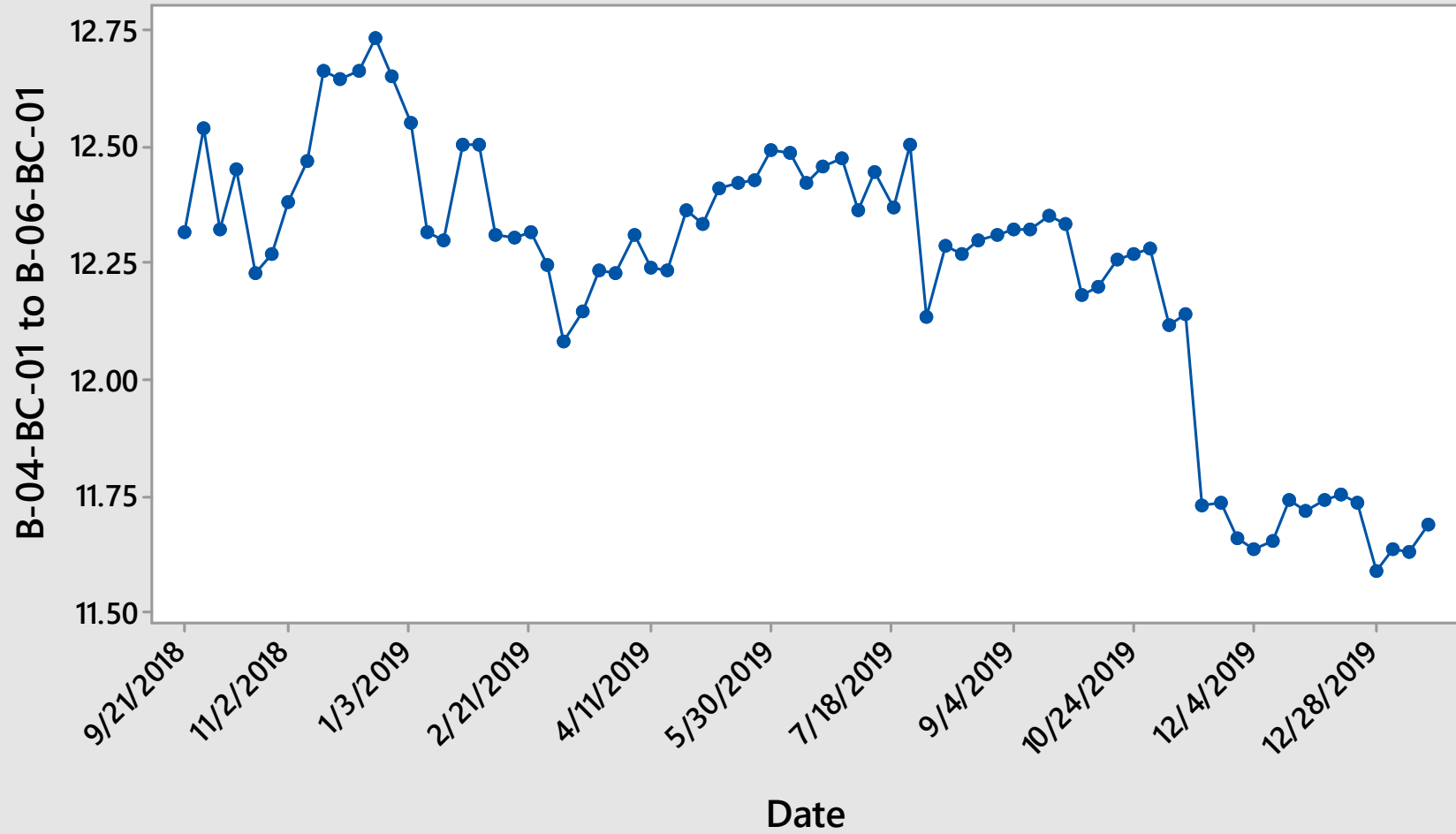


Time Series Plot of B-04-BC-01 to B-05-BC-01  
HORIZON-1

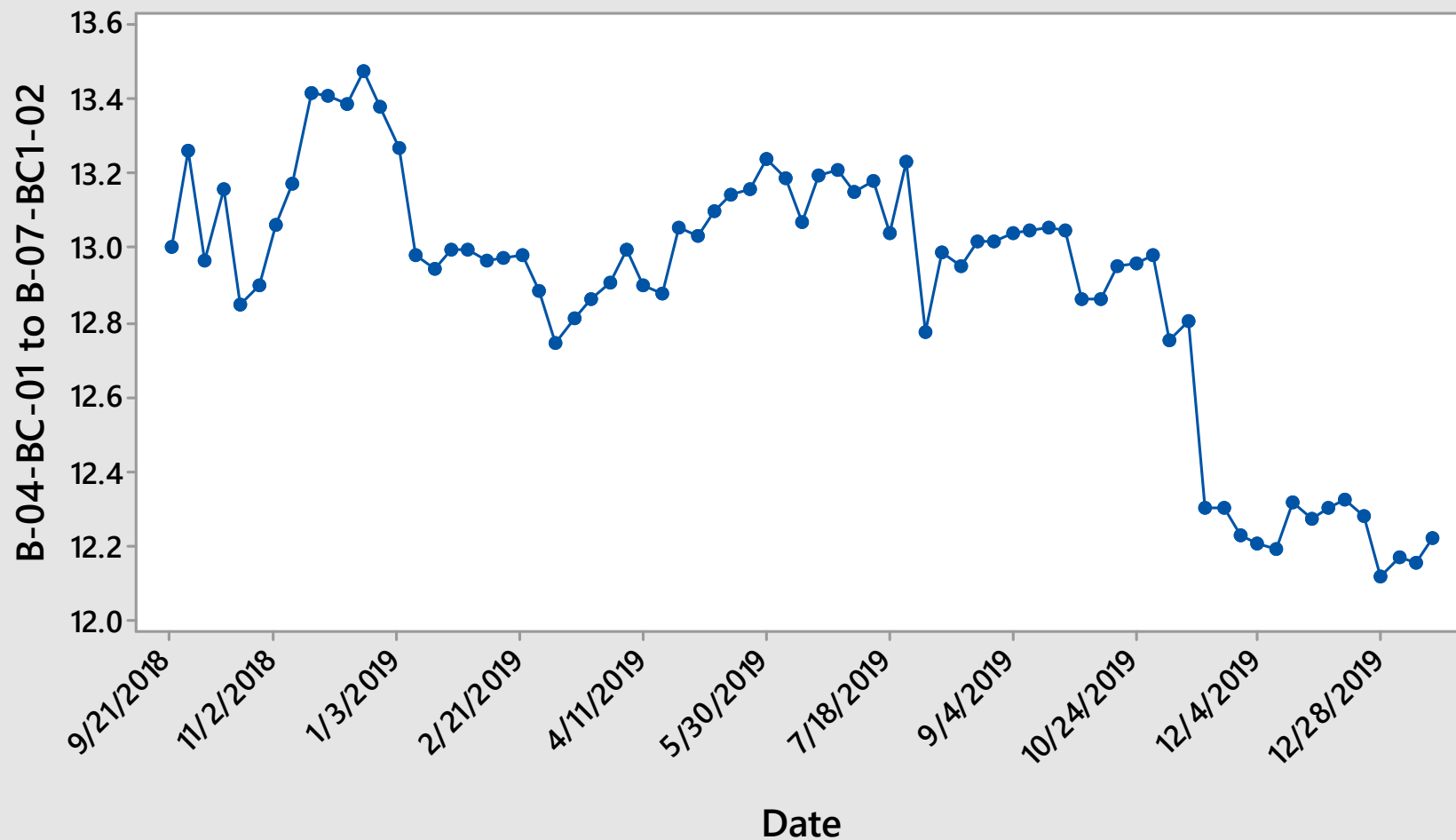




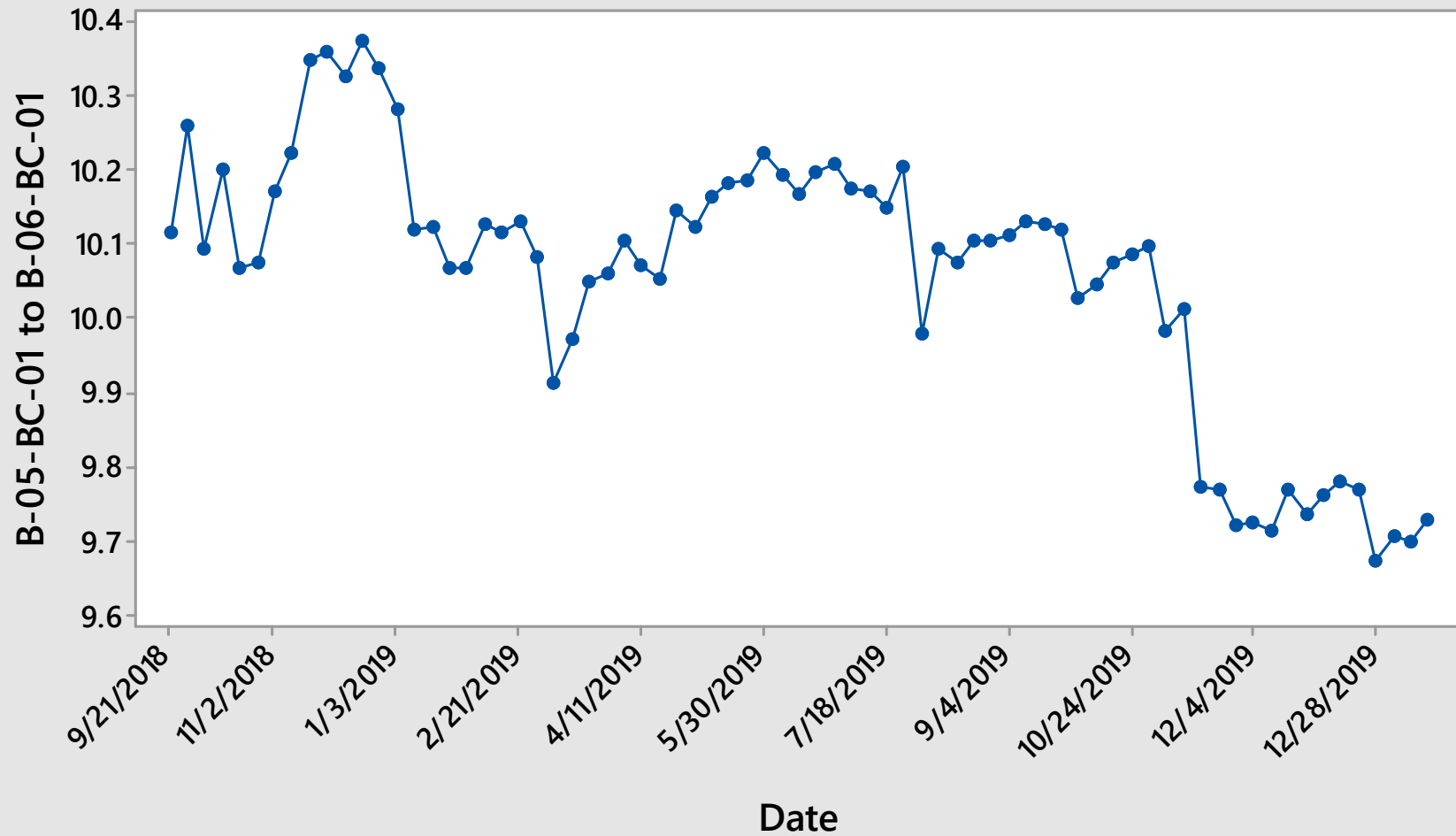
Time Series Plot of B-04-BC-01 to B-06-BC-01  
HORIZON-1



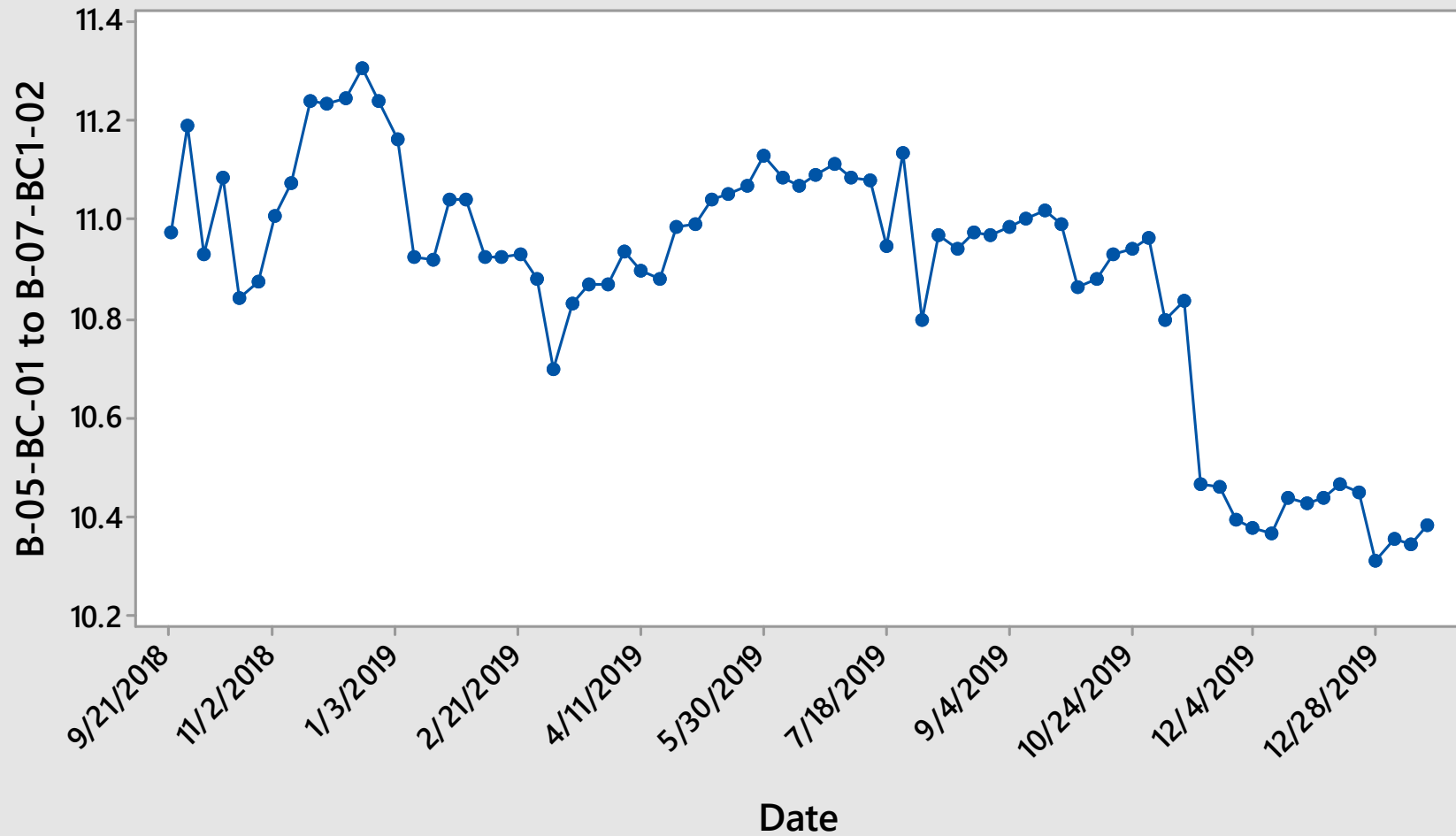
Time Series Plot of B-04-BC-01 to B-07-BC1-02  
HORIZON-1



Time Series Plot of B-05-BC-01 to B-06-BC-01  
HORIZON-1

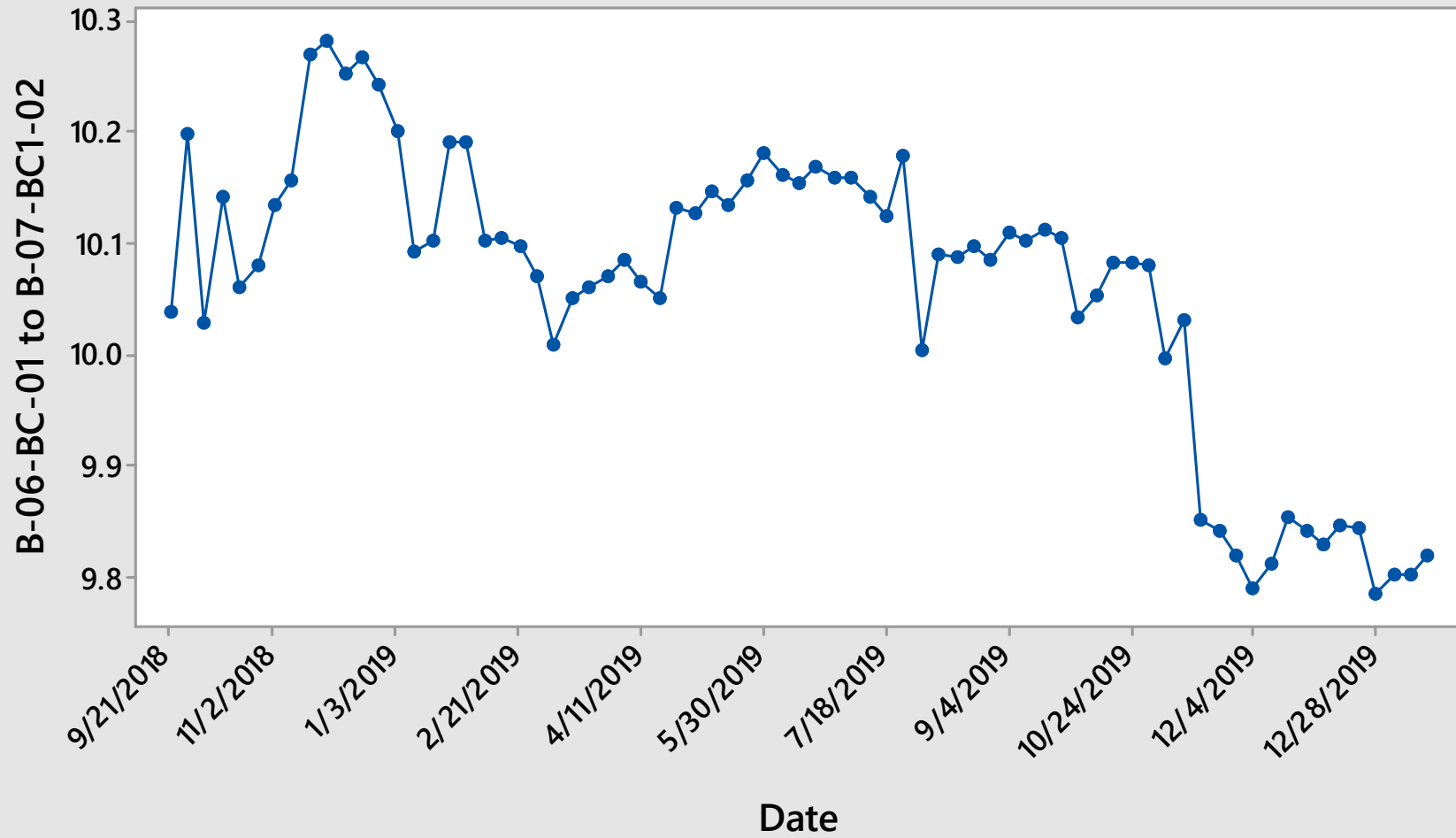


Time Series Plot of B-05-BC-01 to B-07-BC1-02  
HORIZON-1

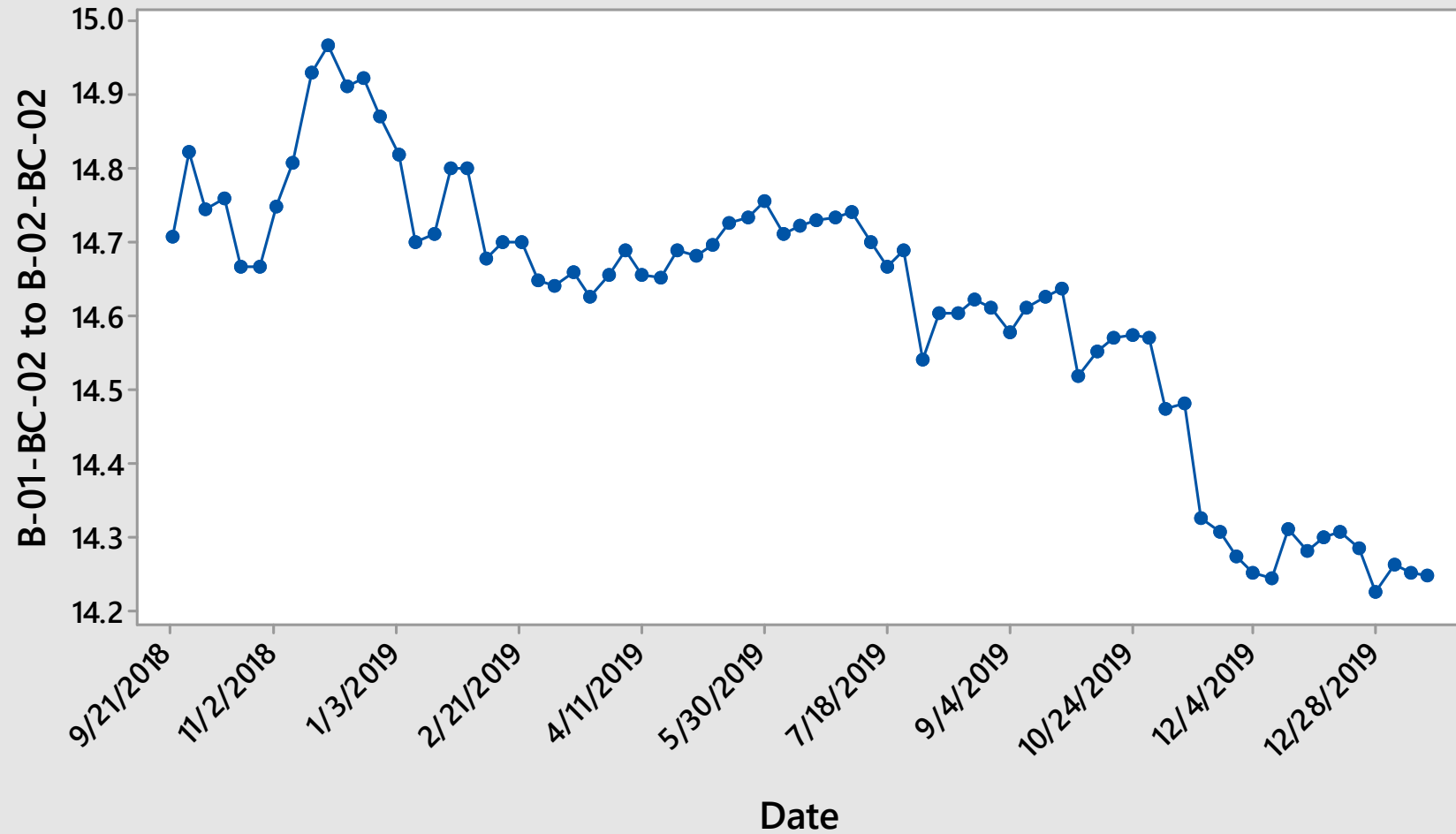




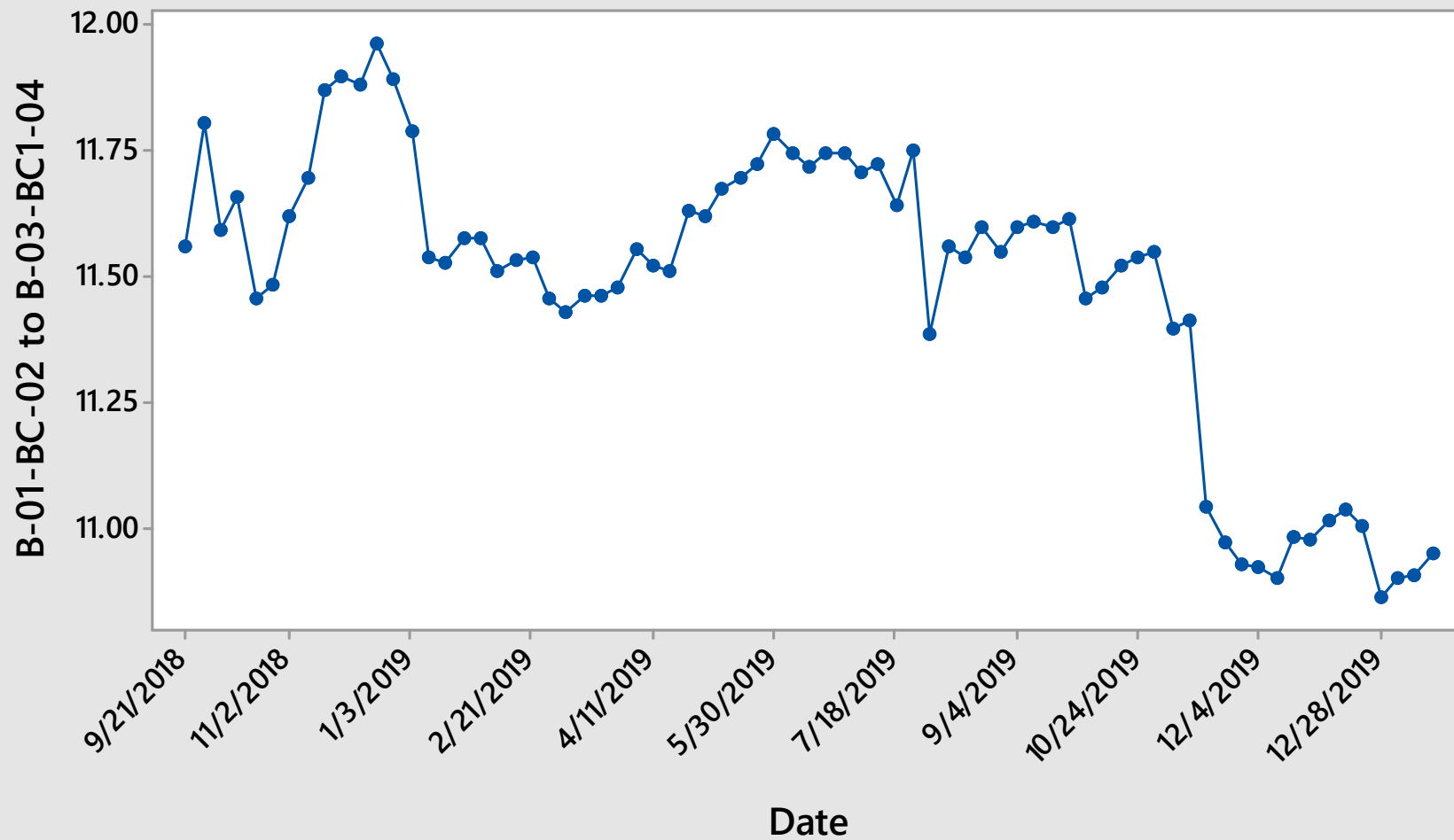
Time Series Plot of B-06-BC-01 to B-07-BC1-02  
HORIZON-1



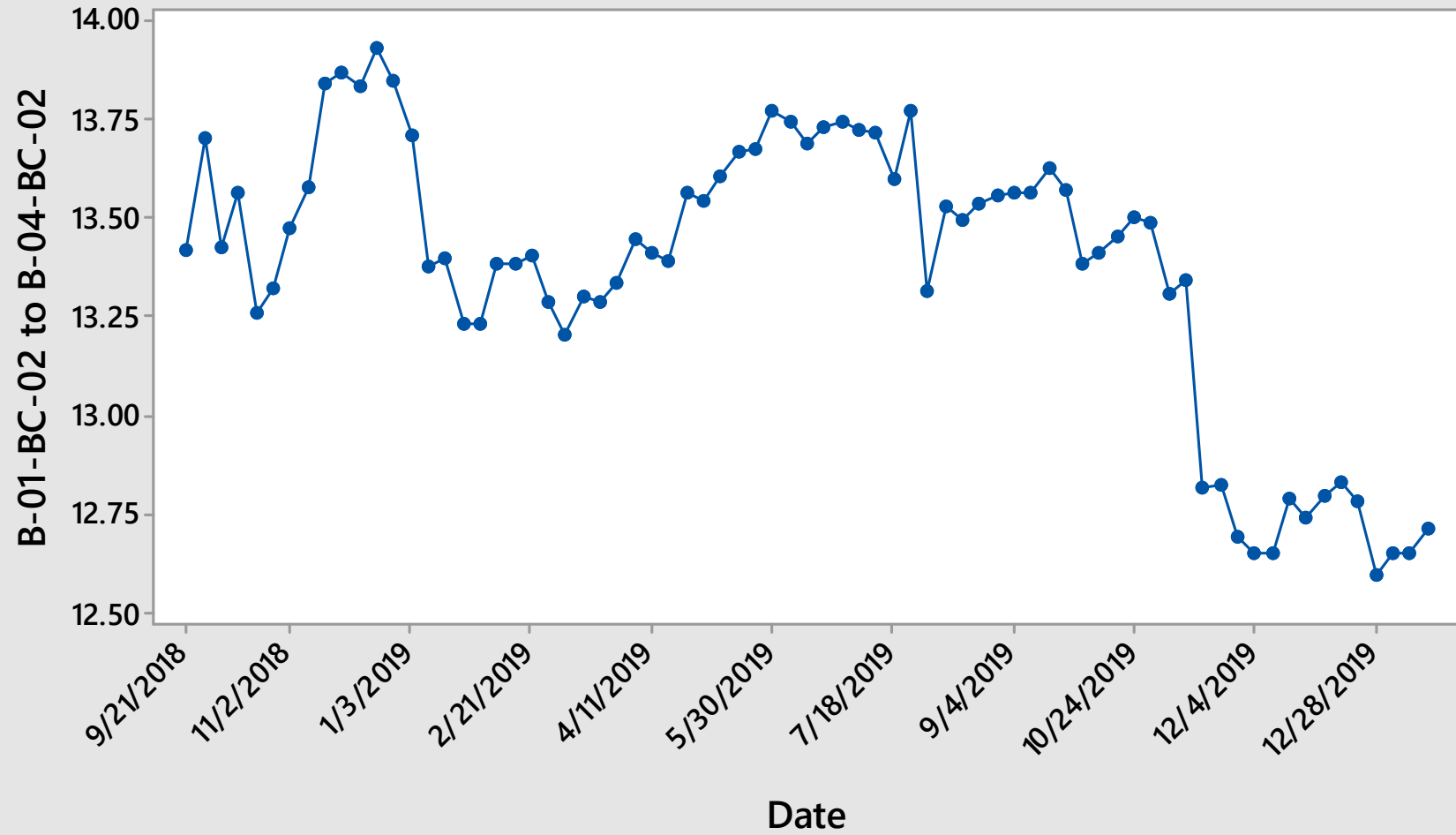
## Time Series Plot of B-01-BC-02 to B-02-BC-02 HORIZON-2



Time Series Plot of B-01-BC-02 to B-03-BC1-04  
HORIZON-2

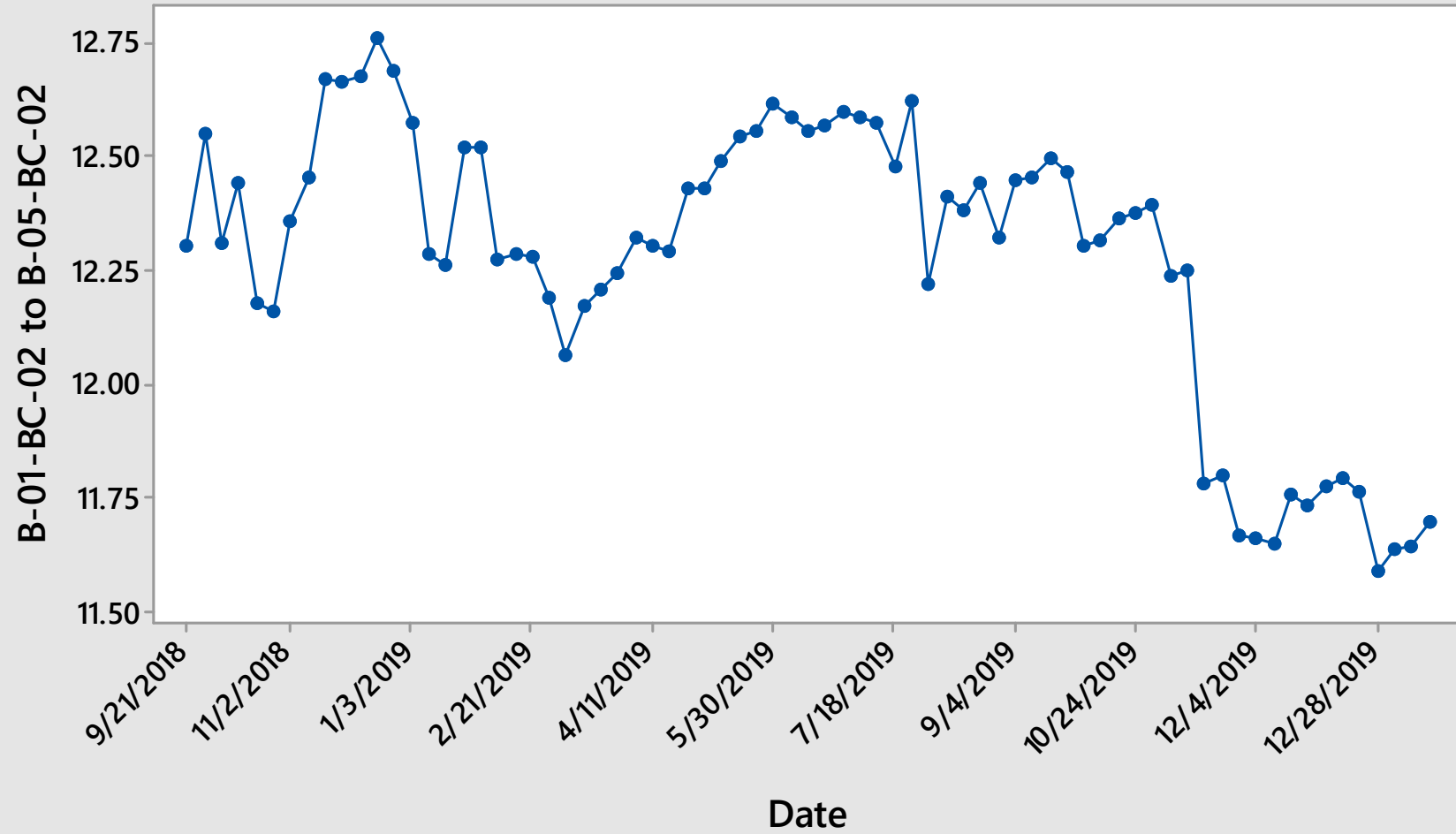


Time Series Plot of B-01-BC-02 to B-04-BC-02  
HORIZON-2

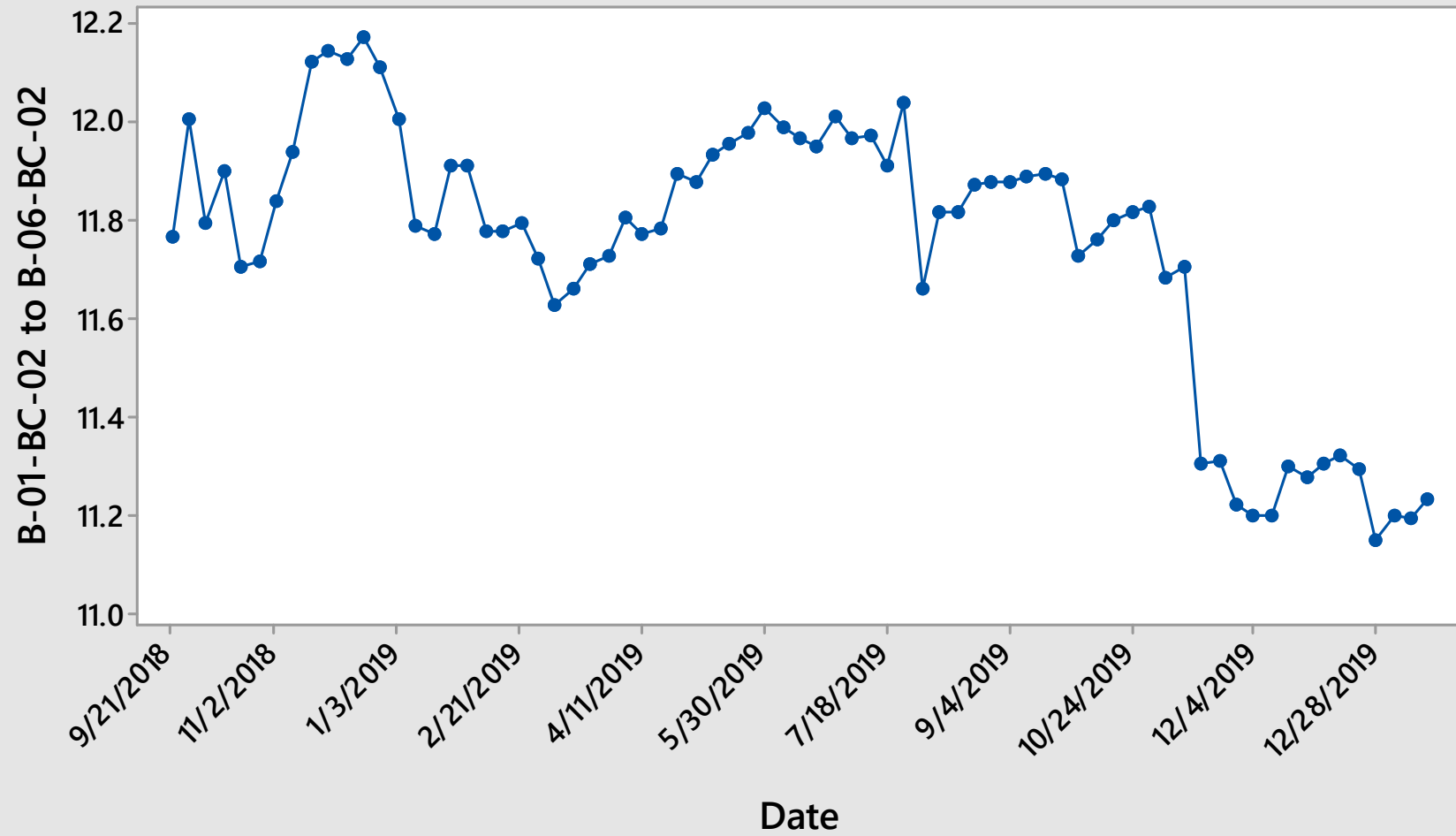




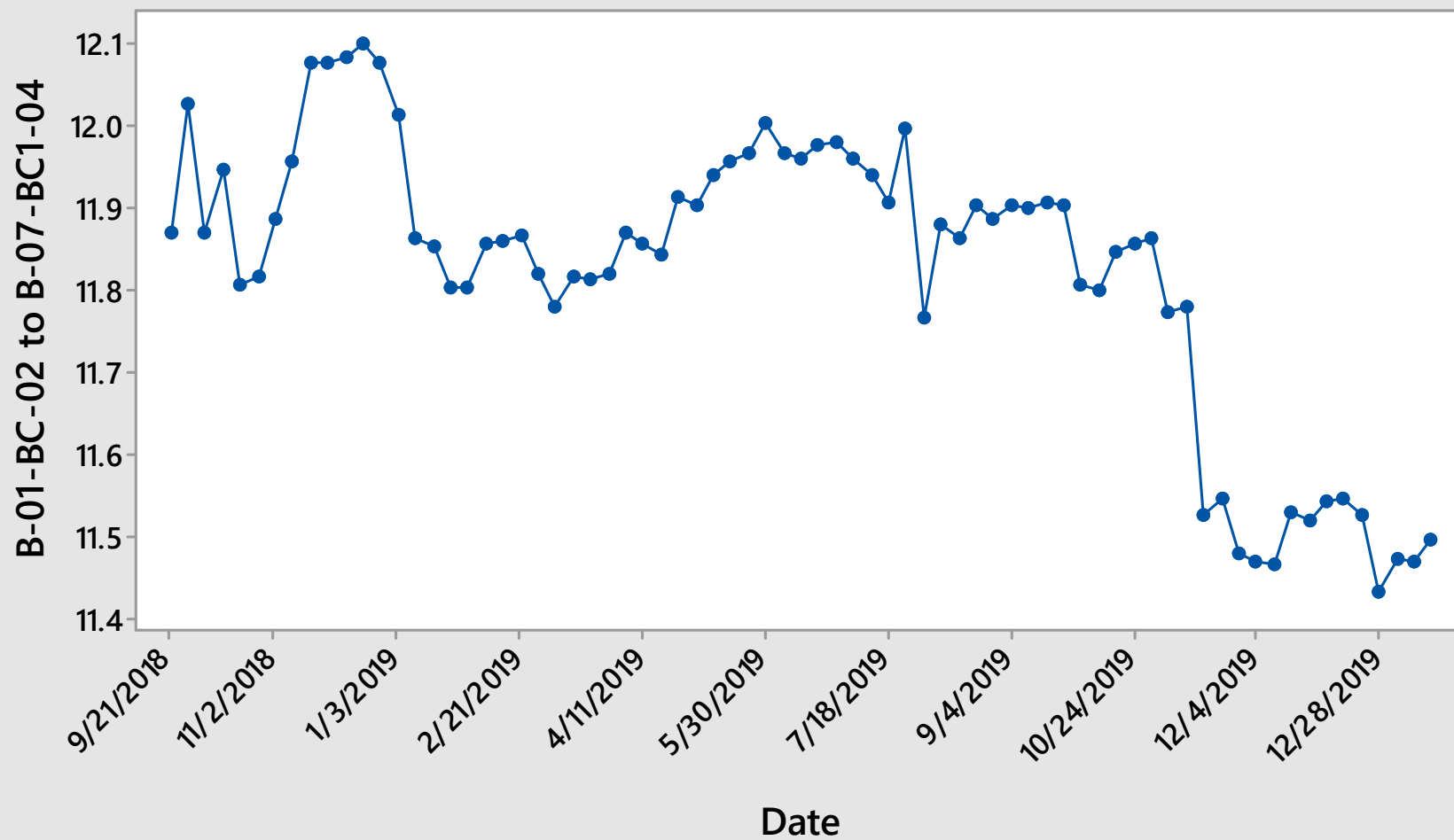
Time Series Plot of B-01-BC-02 to B-05-BC-02  
HORIZON-2



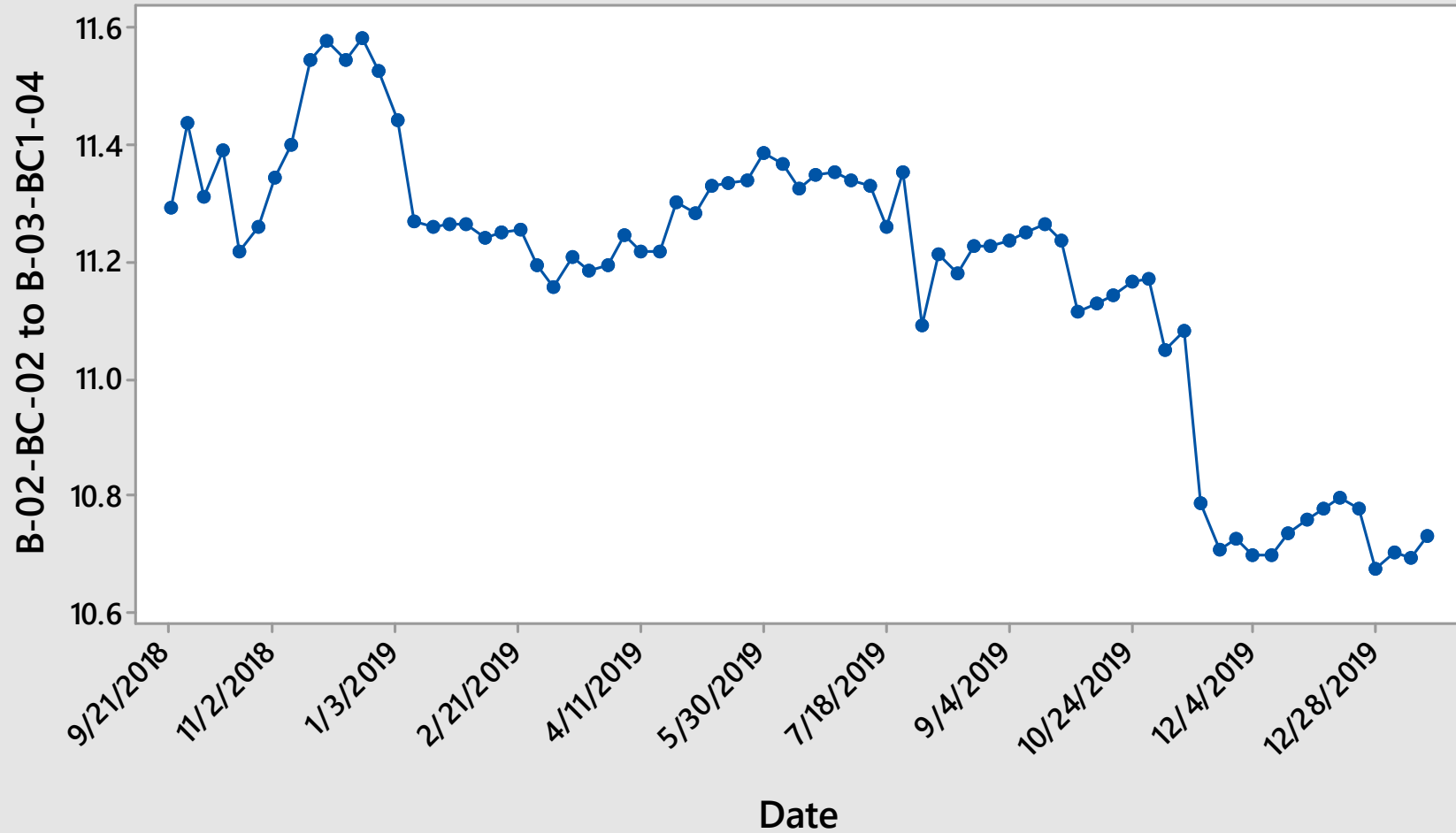
Time Series Plot of B-01-BC-02 to B-06-BC-02  
HORIZON-2



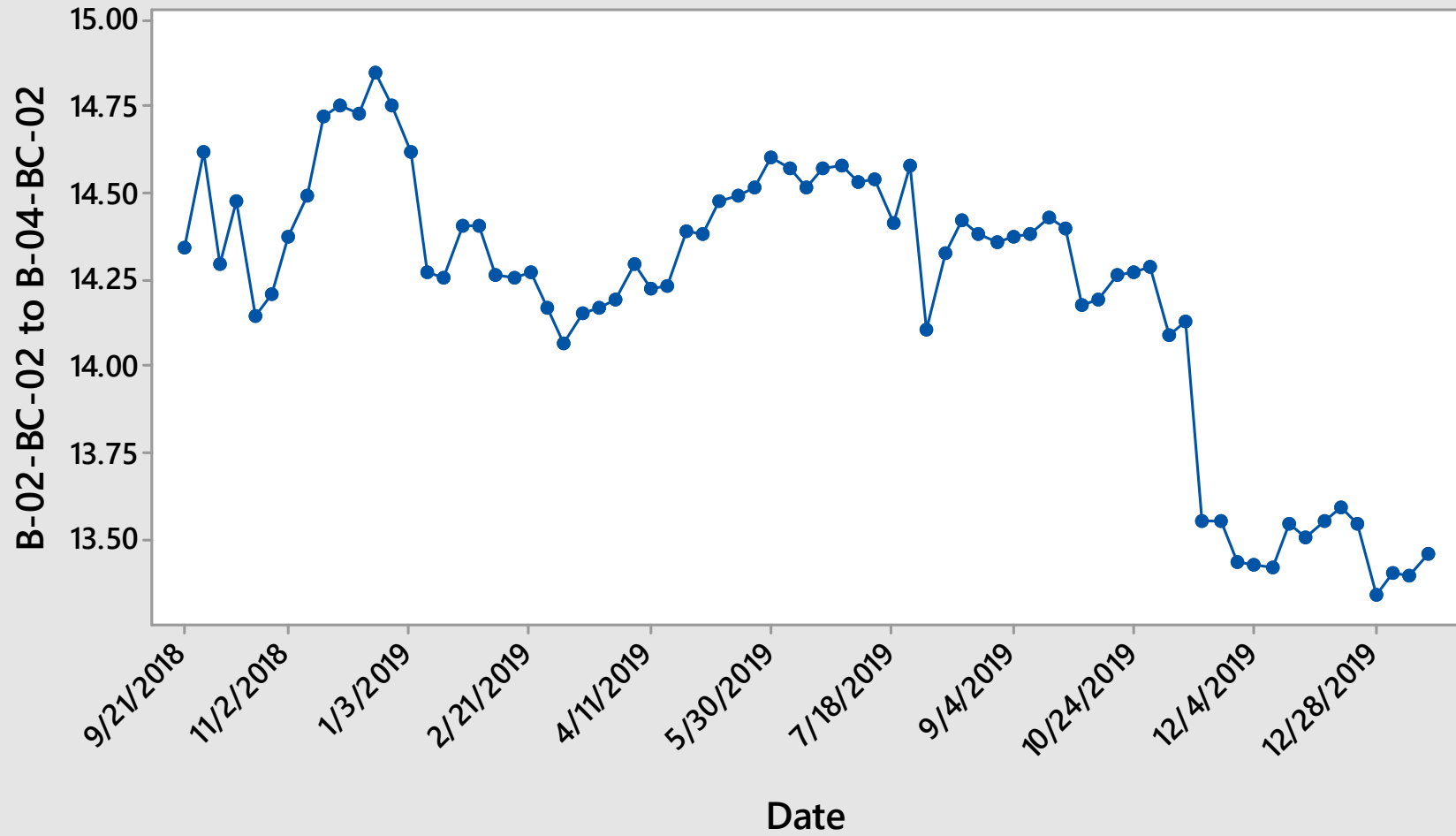
Time Series Plot of B-01-BC-02 to B-07-BC1-04  
HORIZON-2



Time Series Plot of B-02-BC-02 to B-03-BC1-04  
HORIZON-2

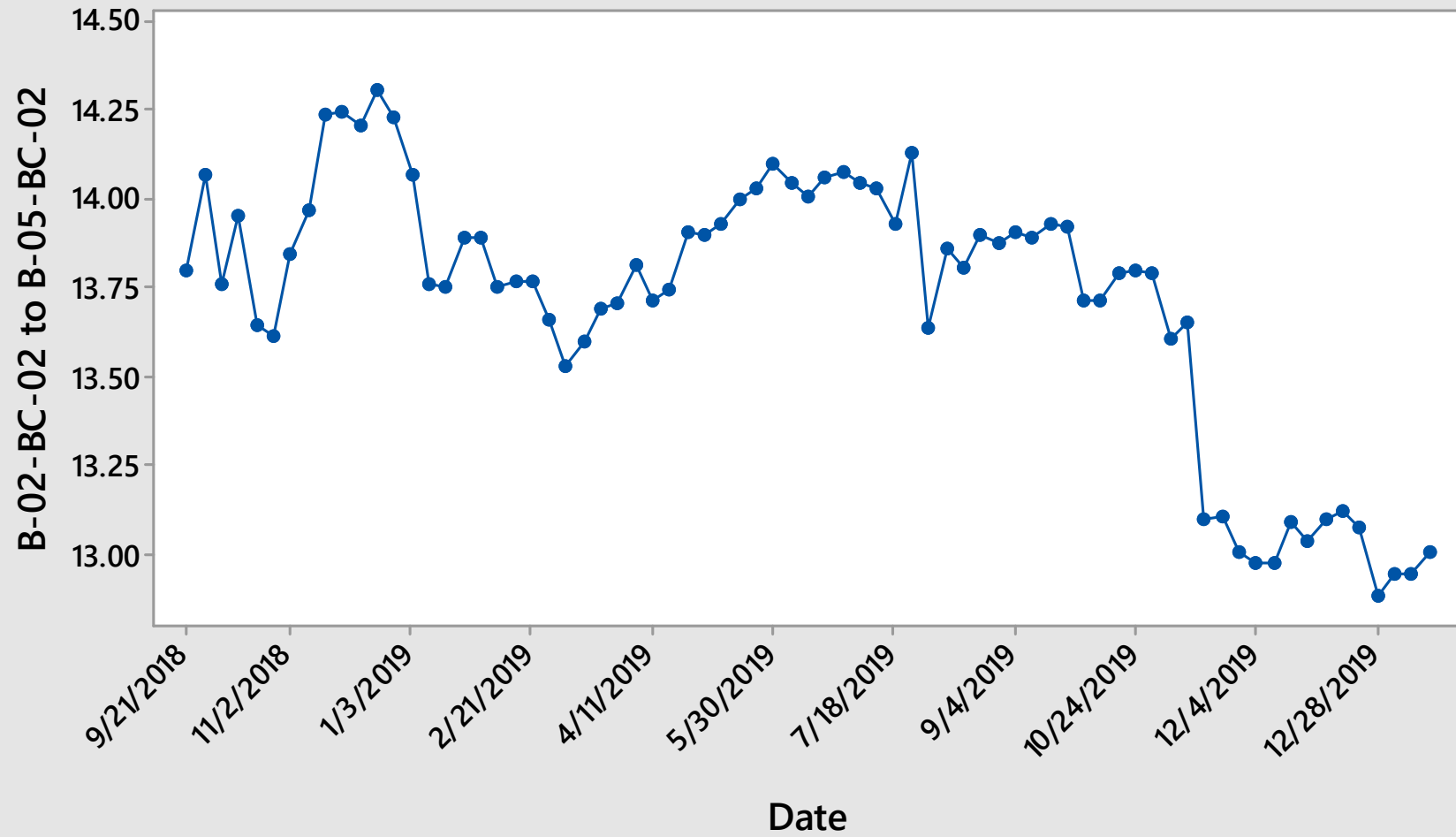


Time Series Plot of B-02-BC-02 to B-04-BC-02  
HORIZON-2

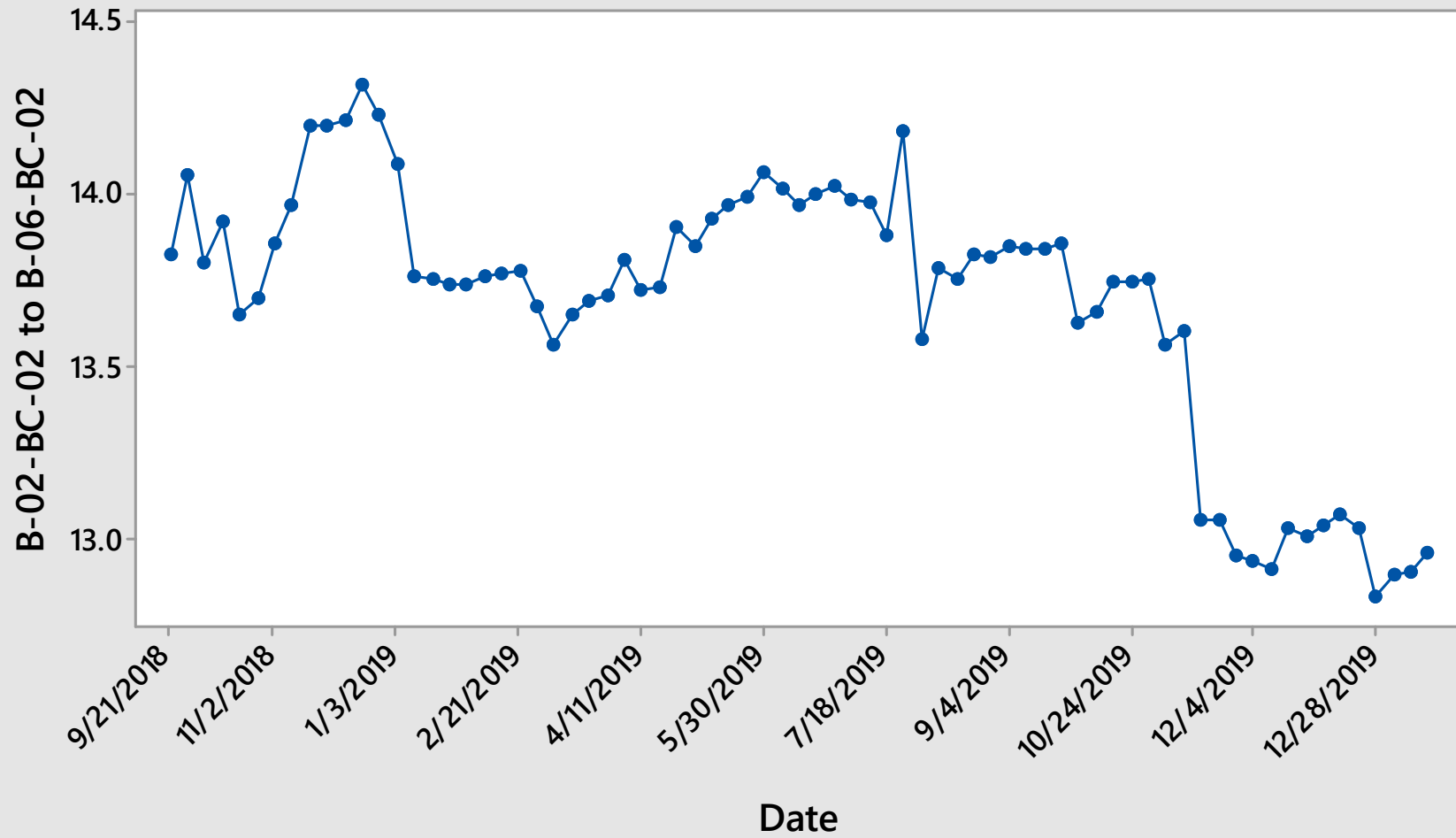




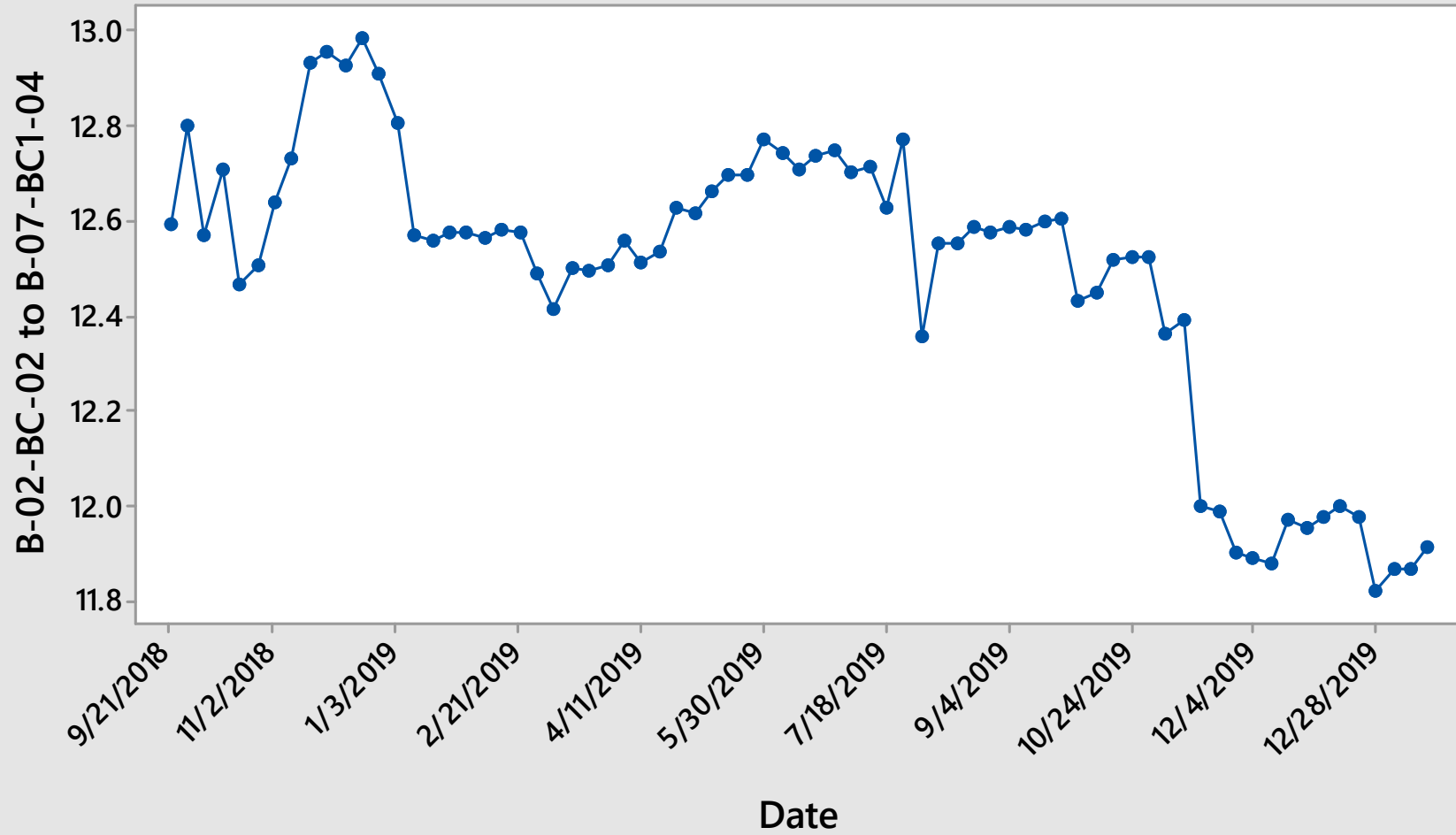
Time Series Plot of B-02-BC-02 to B-05-BC-02  
HORIZON-2



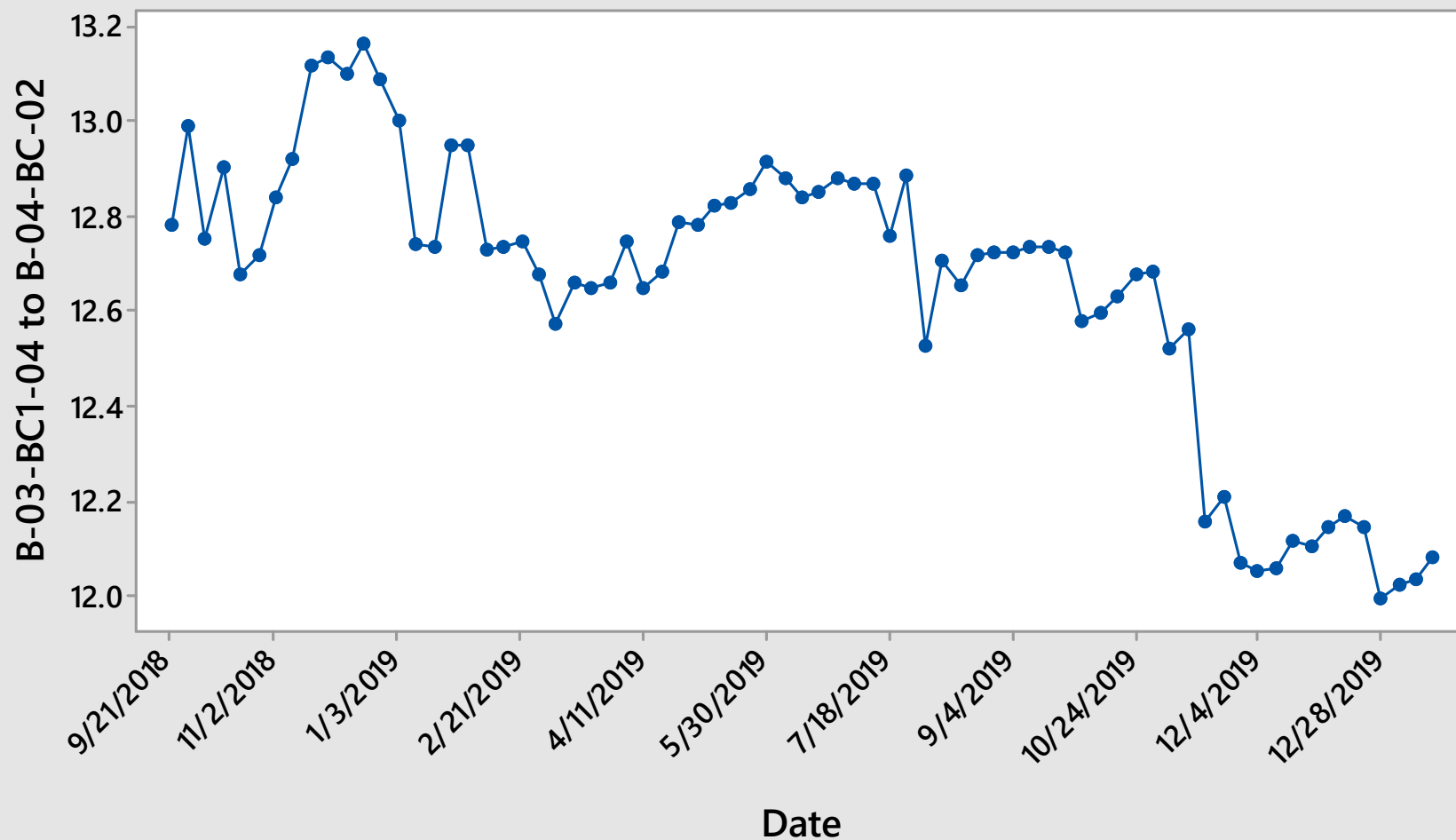
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HORIZON-2



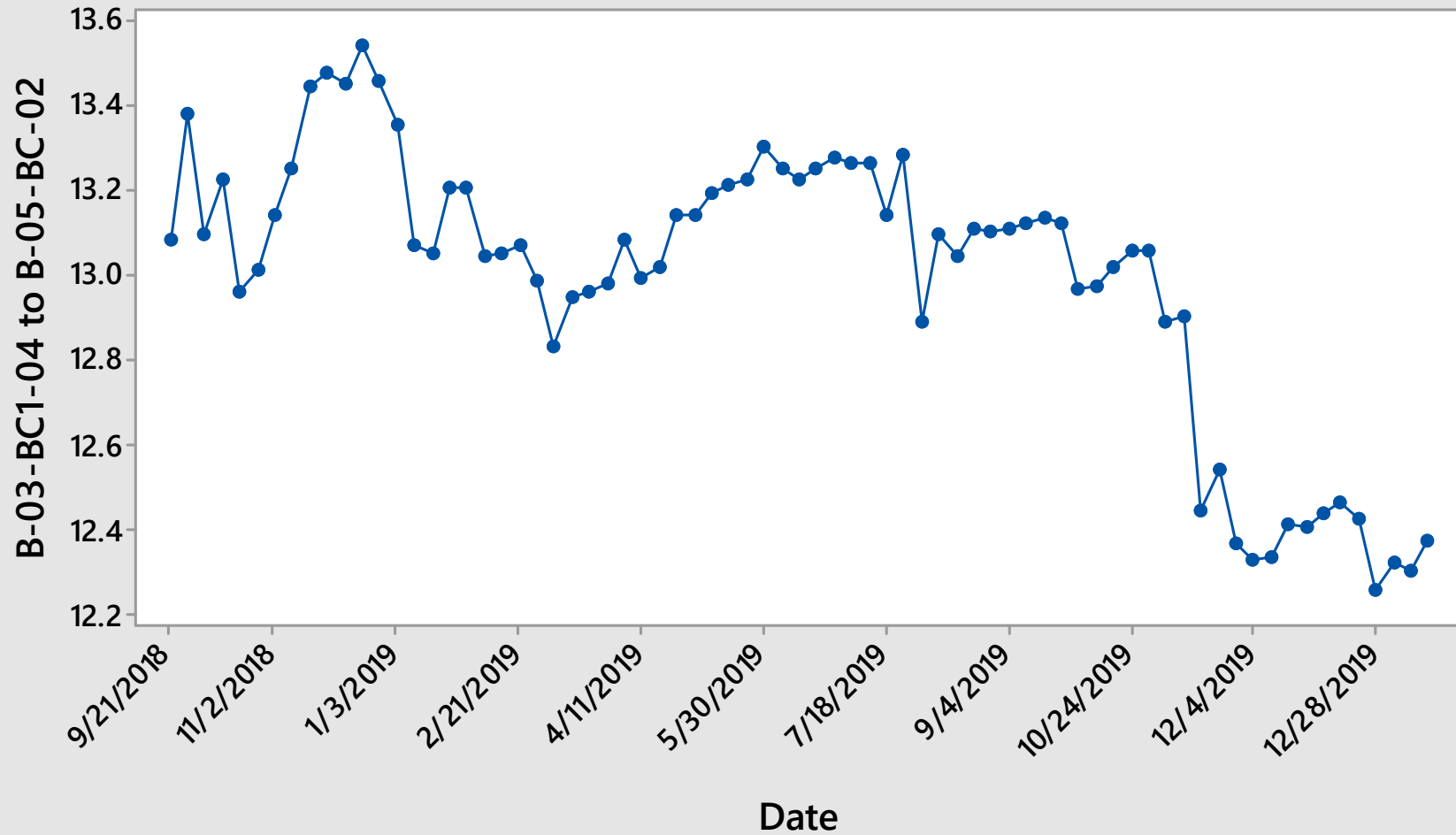
Time Series Plot of B-02-BC-02 to B-07-BC1-04  
HORIZON-2



Time Series Plot of B-03-BC1-04 to B-04-BC-02  
HORIZON-2

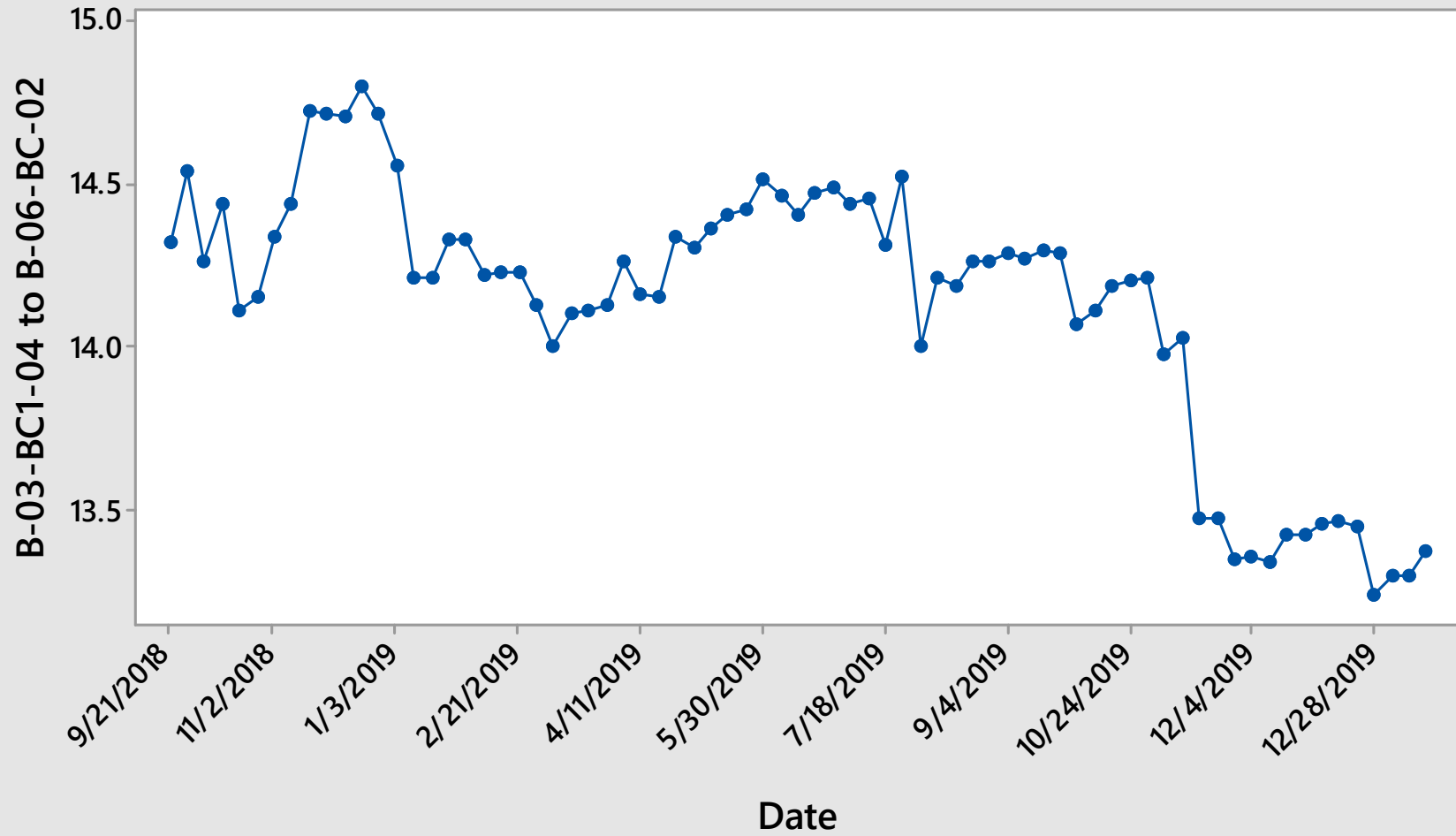


Time Series Plot of B-03-BC1-04 to B-05-BC-02  
HORIZON-2

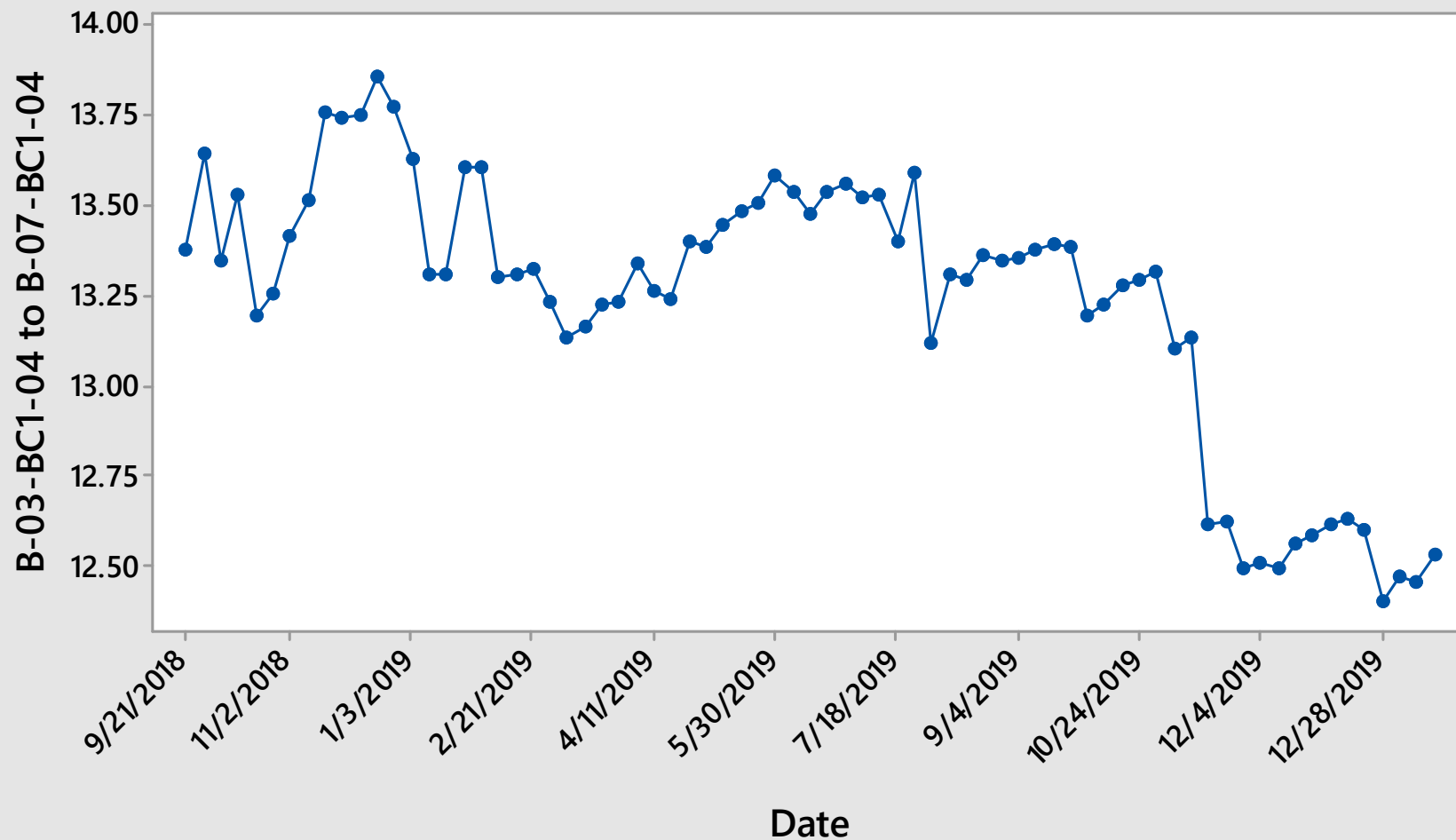




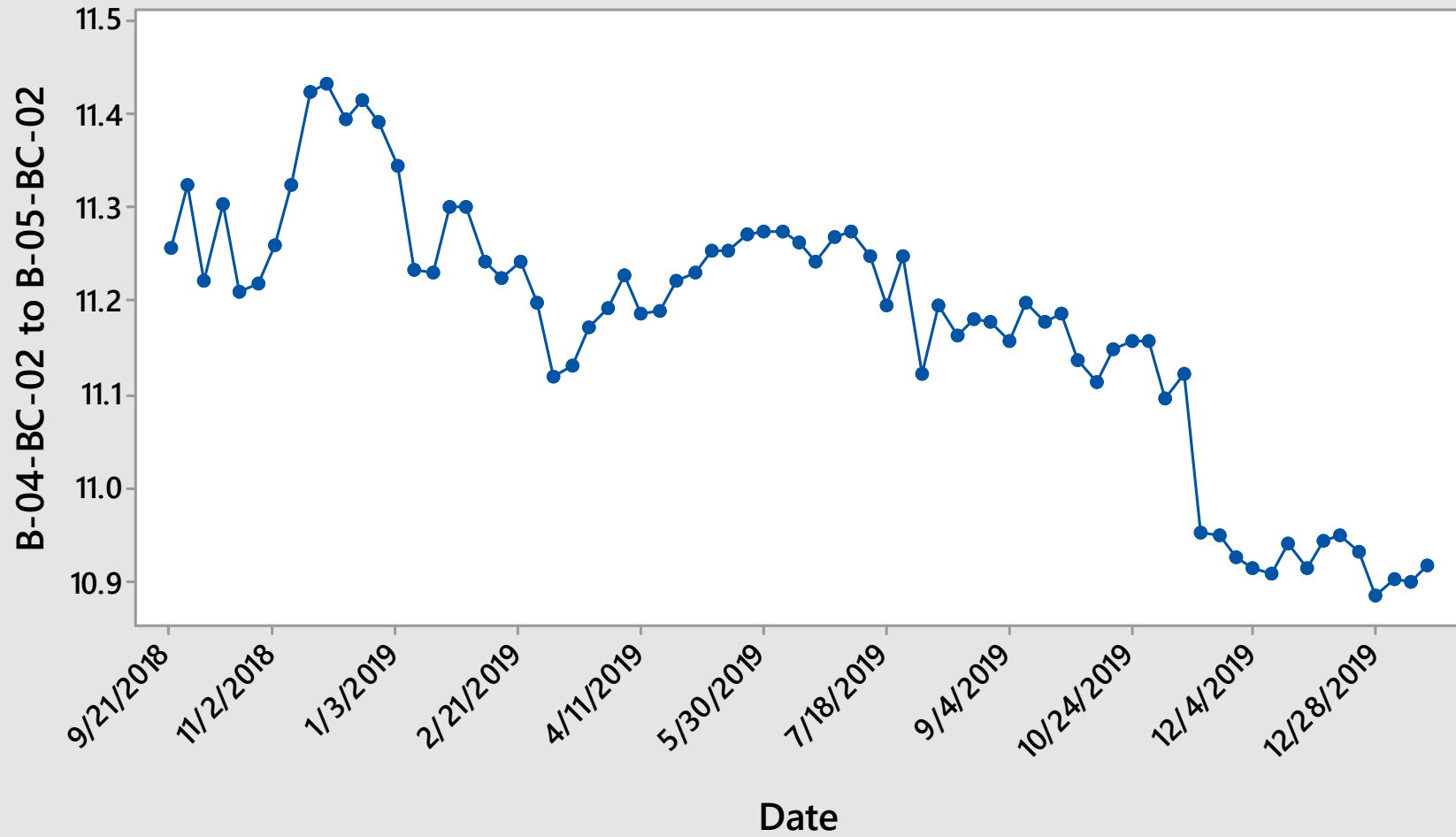
Time Series Plot of B-03-BC1-04 to B-06-BC-02  
HORIZON-2



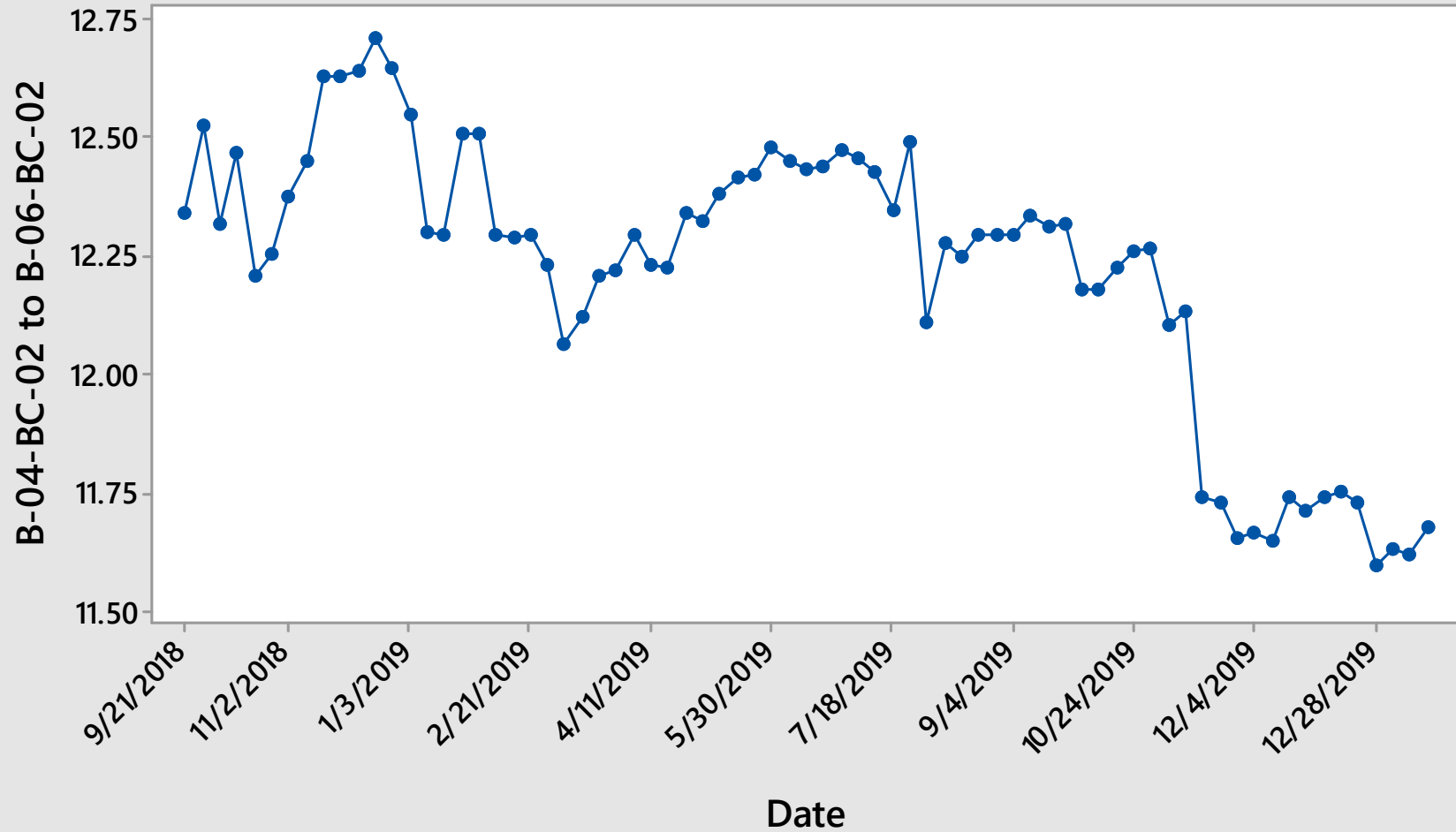
Time Series Plot of B-03-BC1-04 to B-07-BC1-04  
HORIZON-2



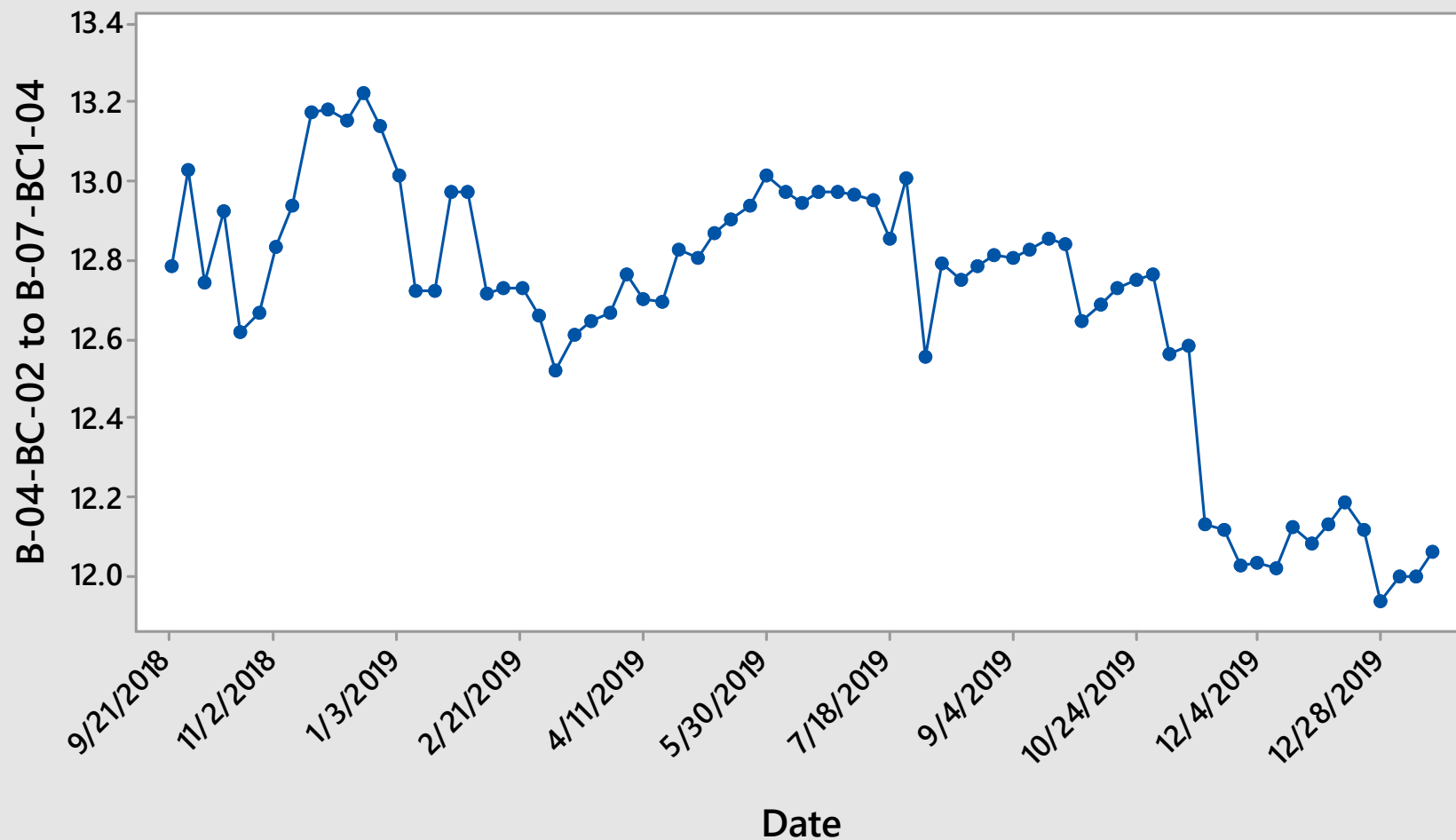
Time Series Plot of B-04-BC-02 to B-05-BC-02  
HORIZON-2



Time Series Plot of B-04-BC-02 to B-06-BC-02  
HORIZON-2

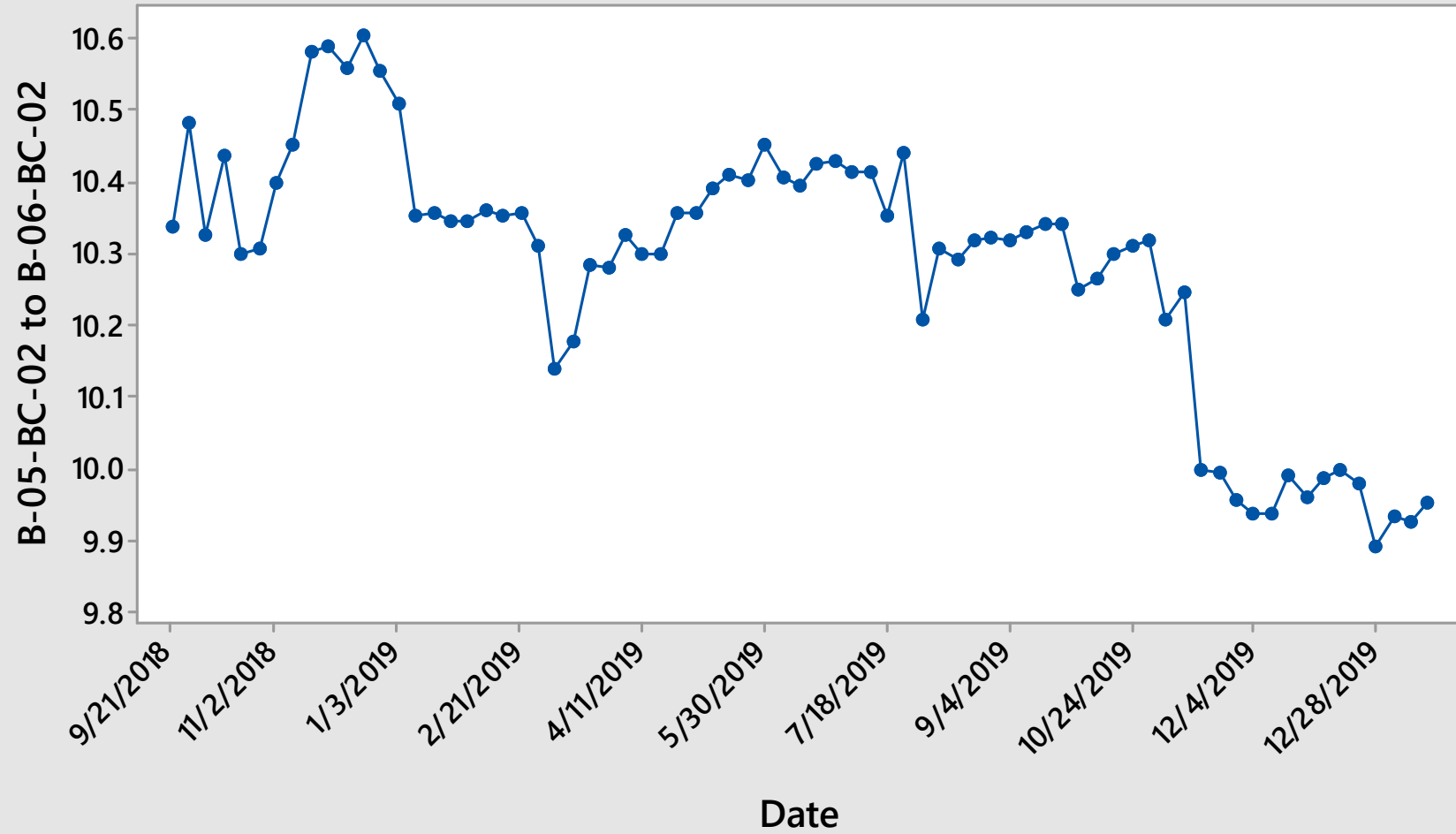


Time Series Plot of B-04-BC-02 to B-07-BC1-04  
HORIZON-2

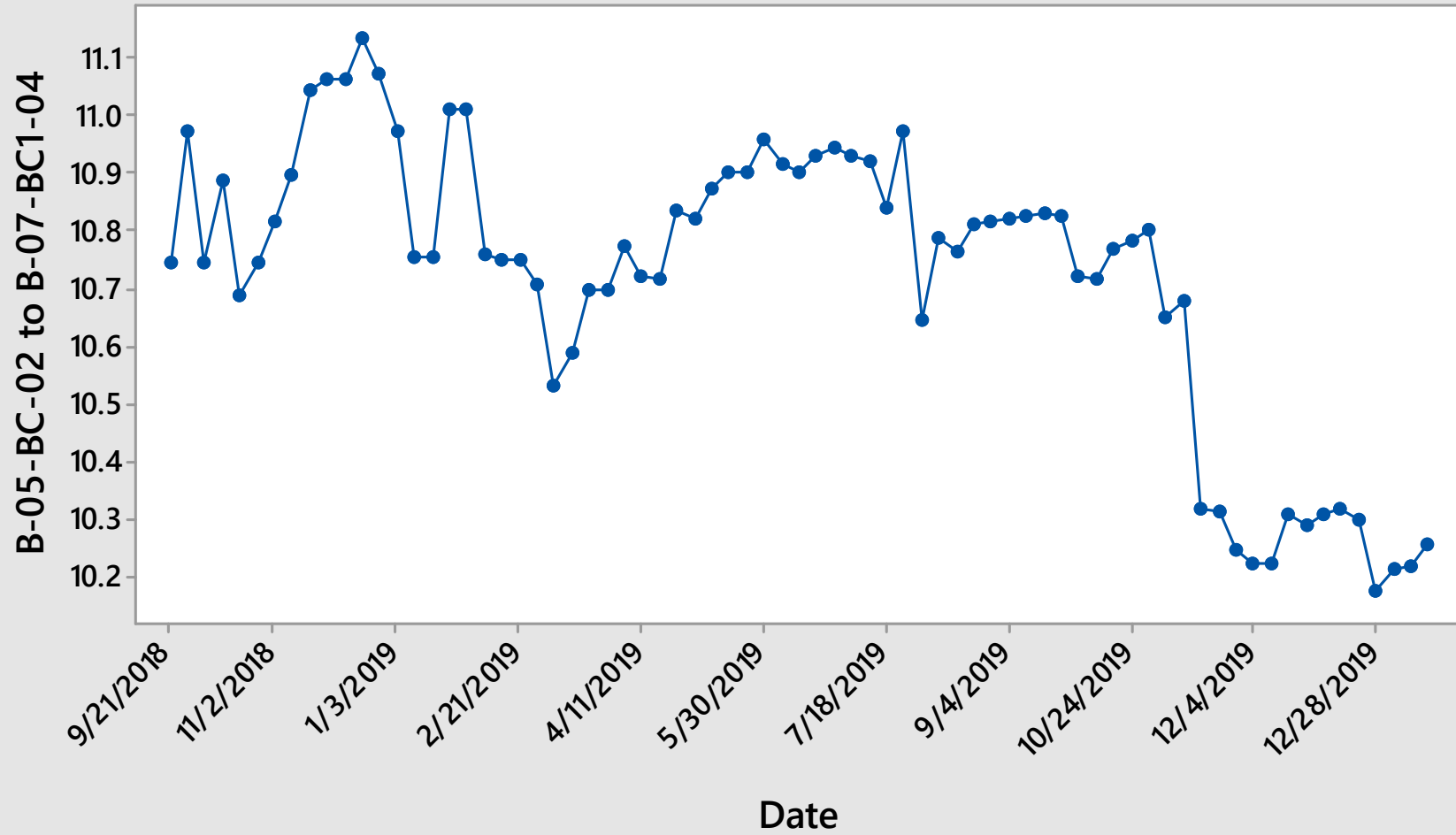




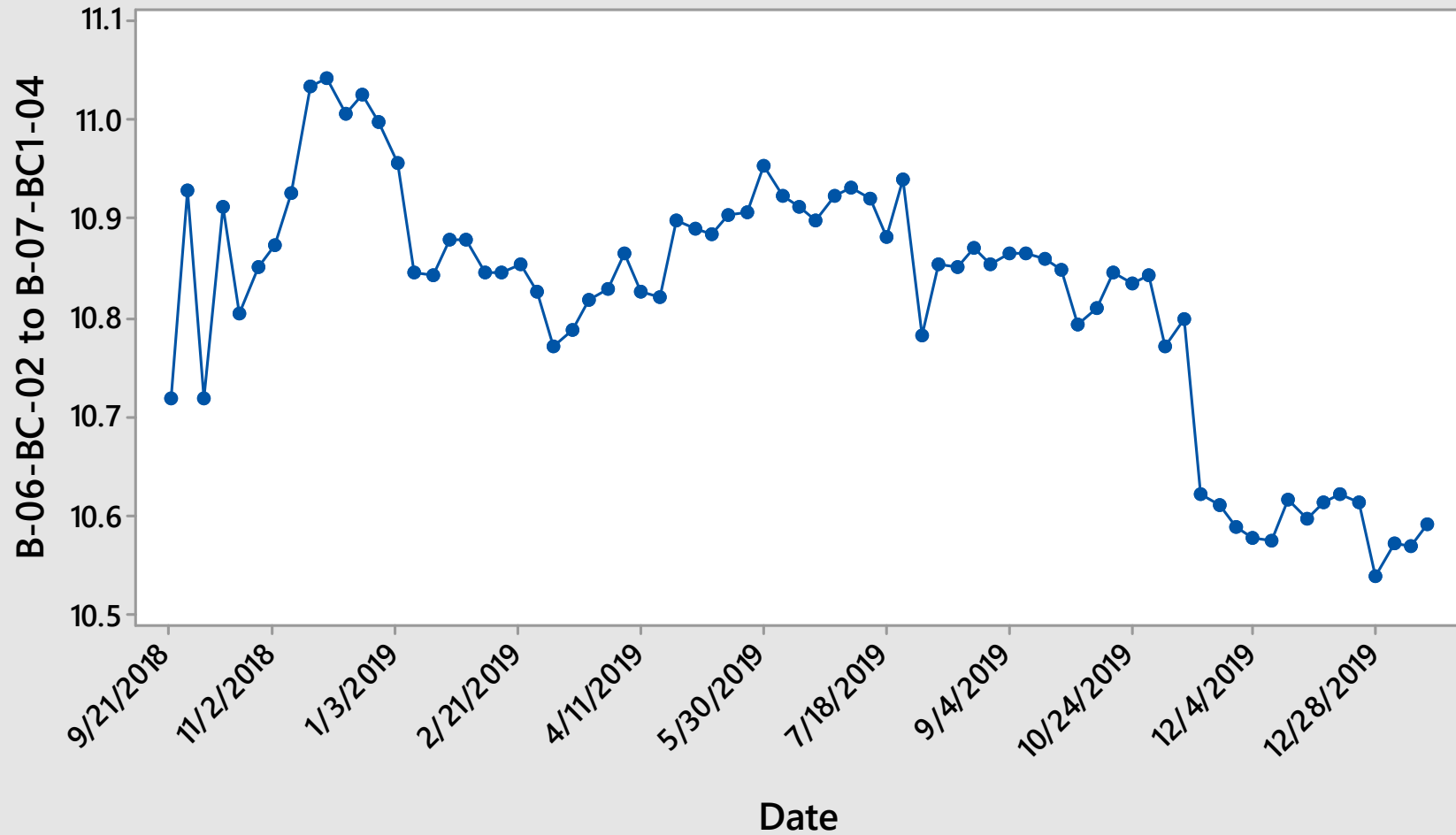
Time Series Plot of B-05-BC-02 to B-06-BC-02  
HORIZON-2



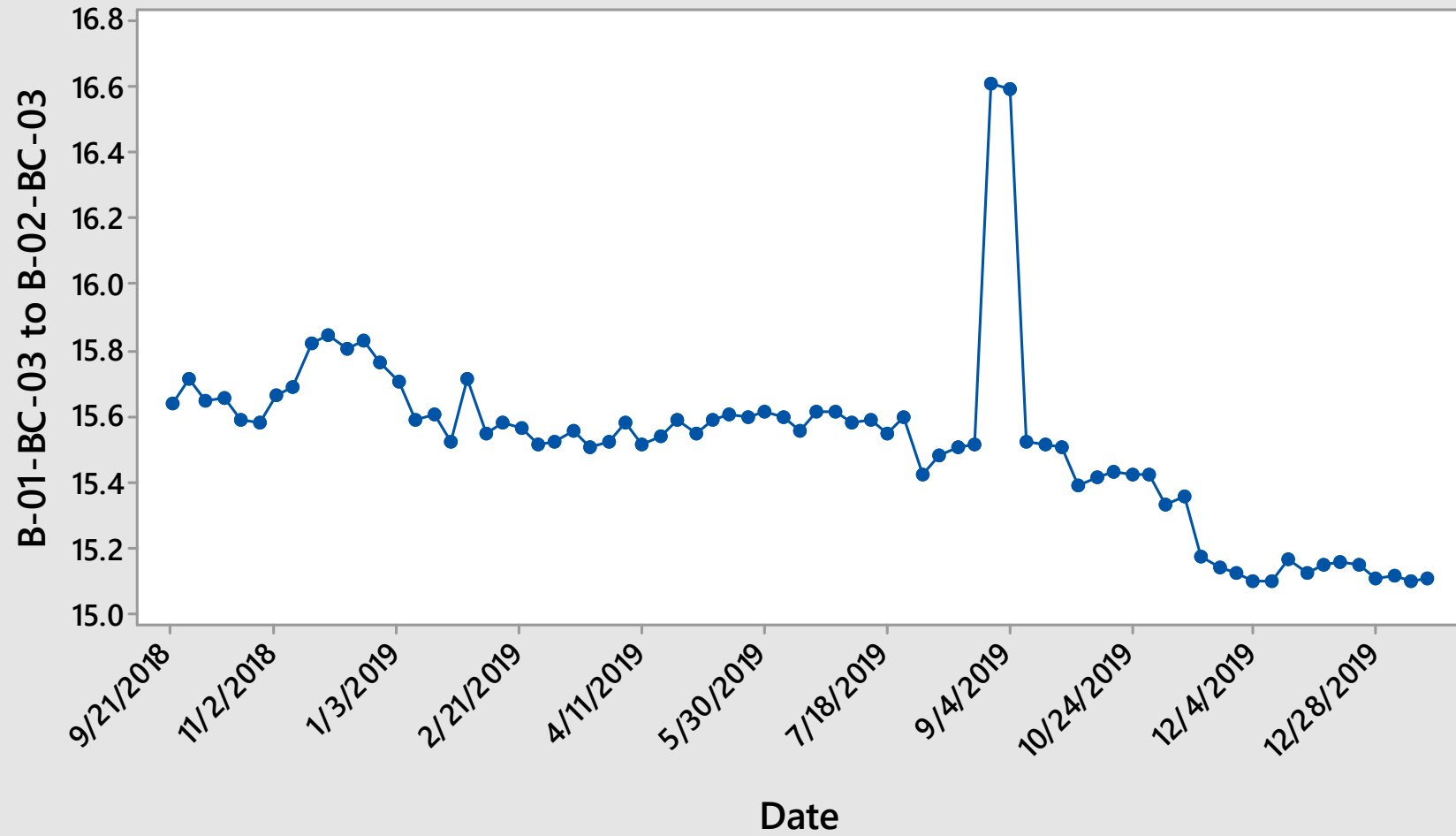
Time Series Plot of B-05-BC-02 to B-07-BC1-04  
HORIZON-2



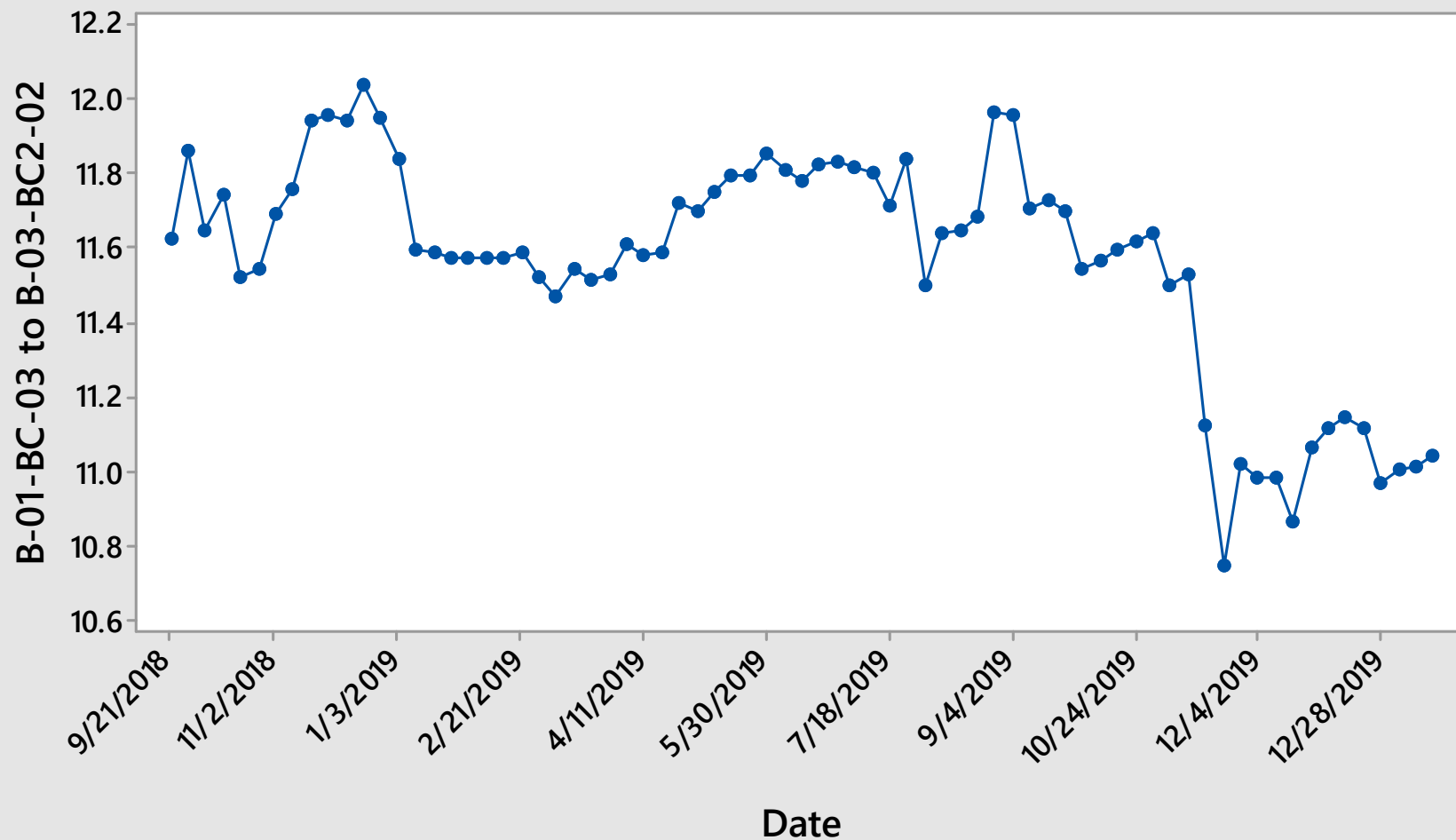
Time Series Plot of B-06-BC-02 to B-07-BC1-04  
HORIZON-2



Time Series Plot of B-01-BC-03 to B-02-BC-03  
HORIZON-3

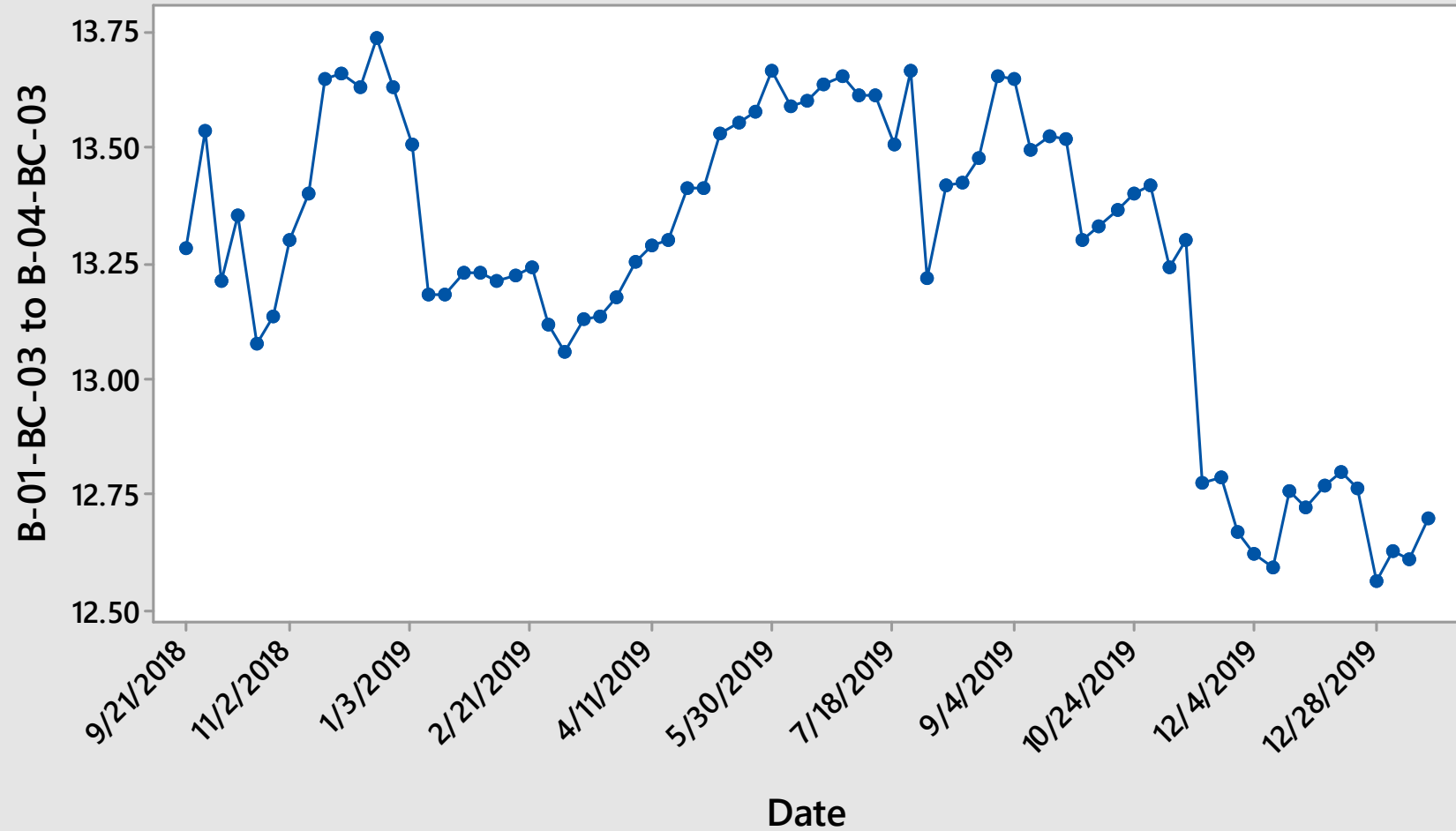


Time Series Plot of B-01-BC-03 to B-03-BC2-02  
HORIZON-3

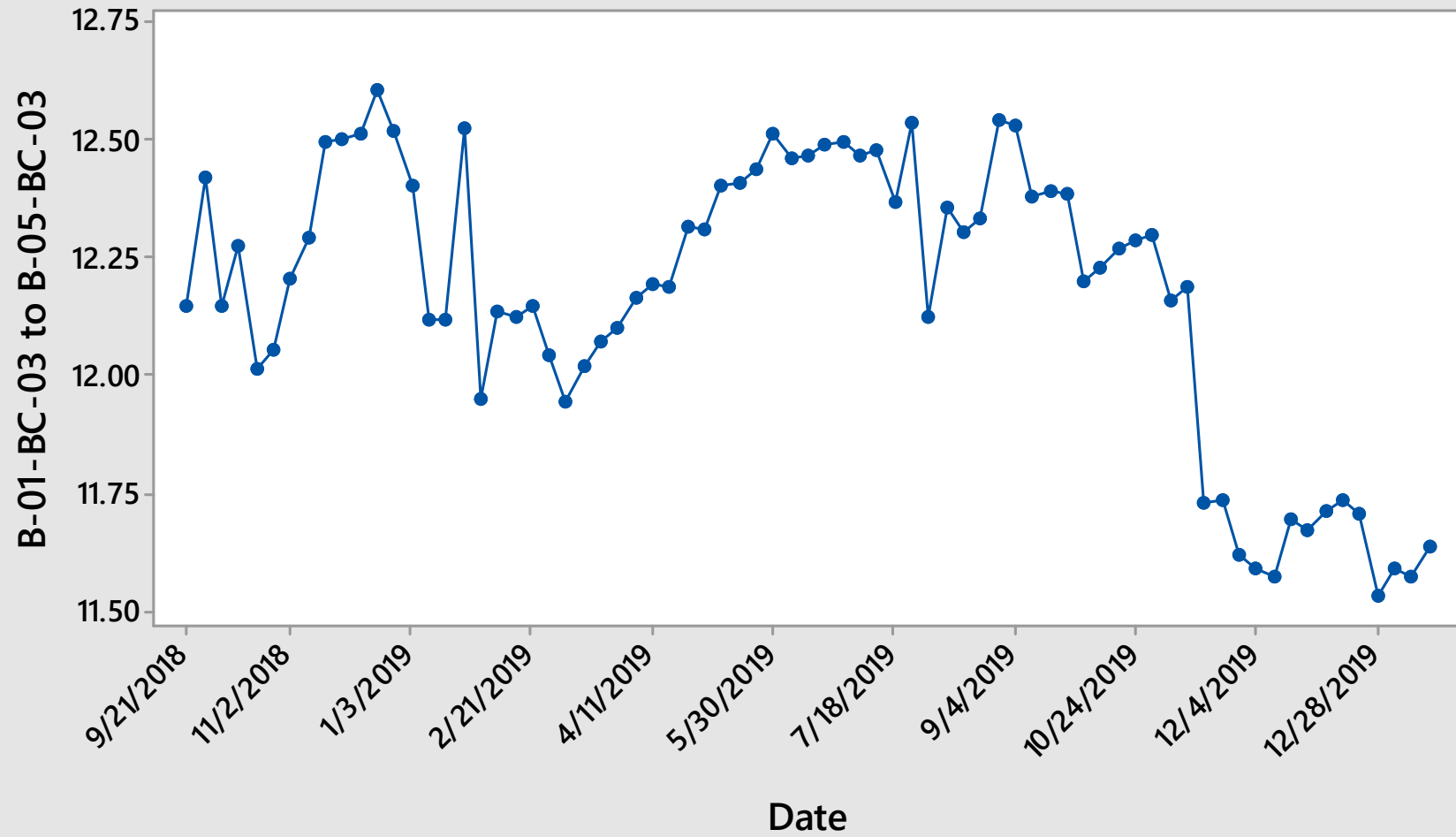




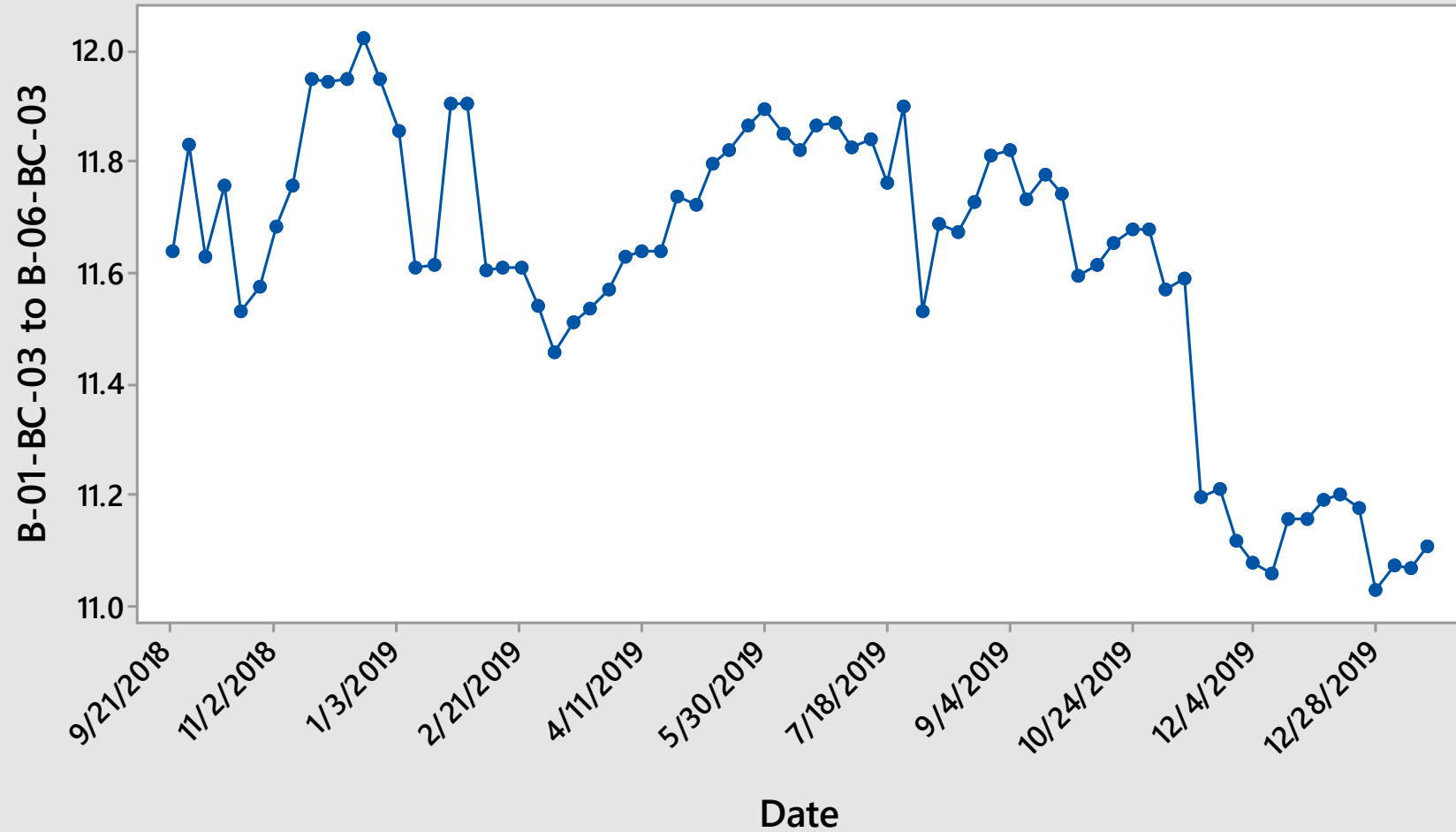
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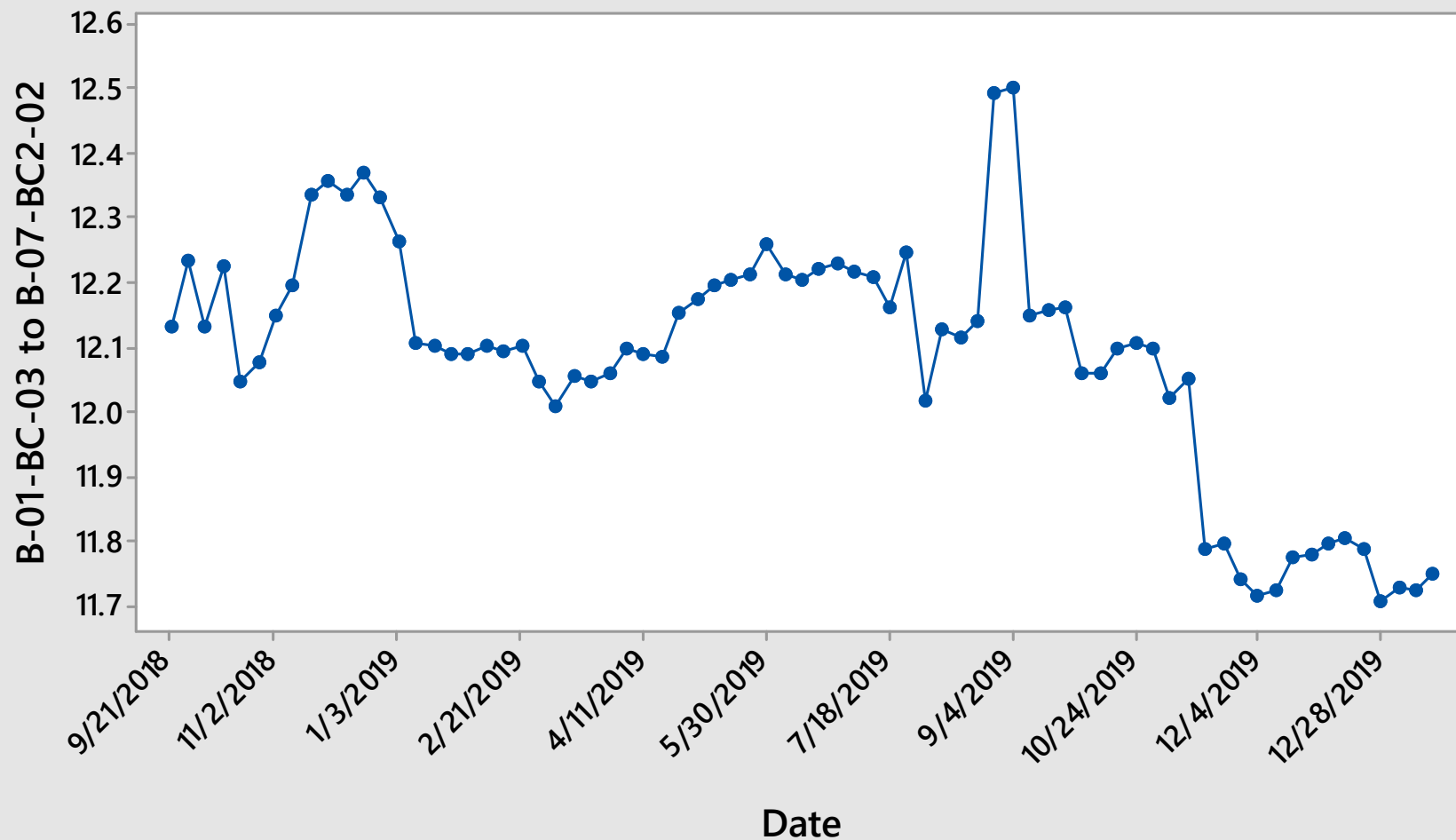
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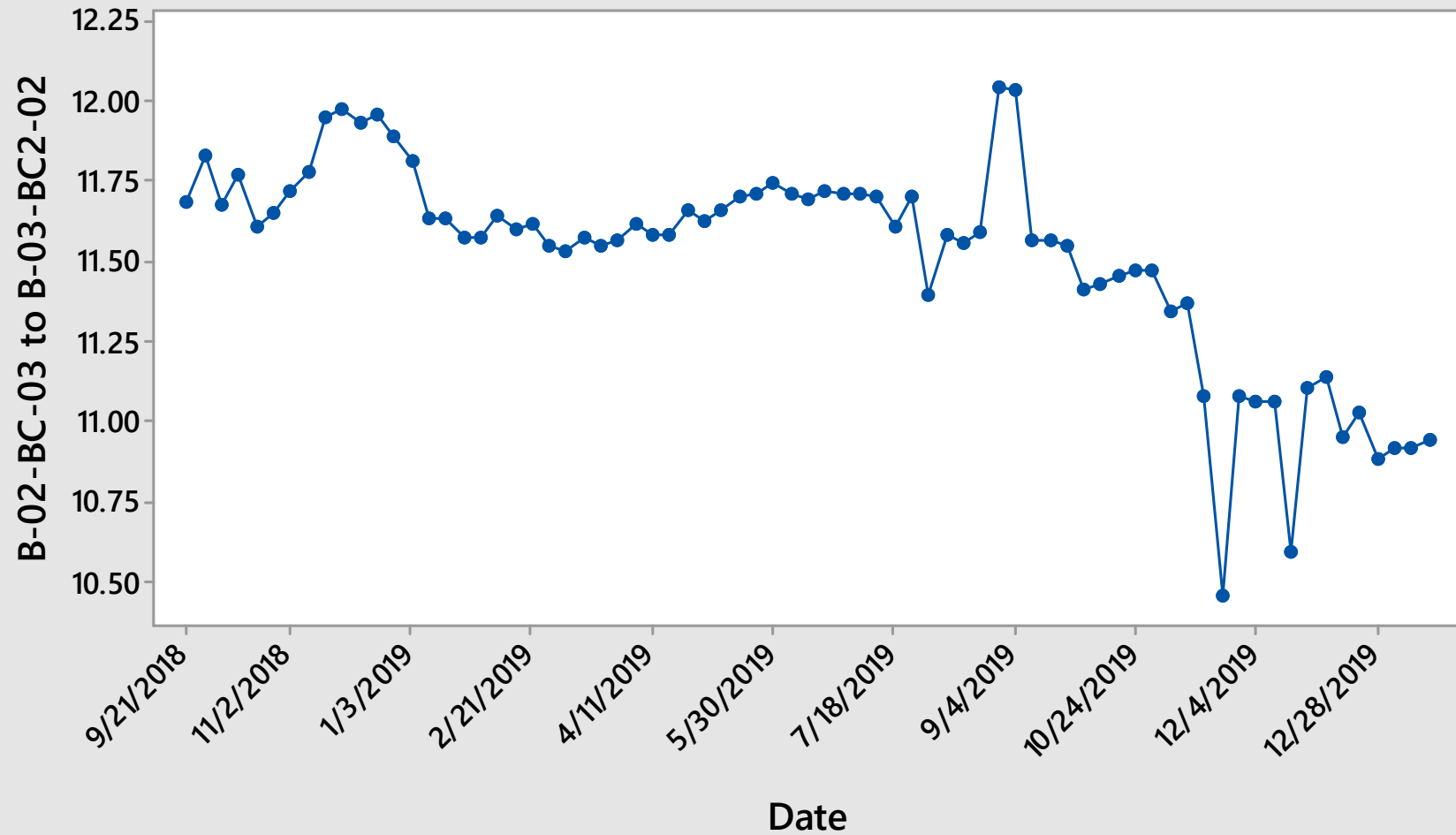
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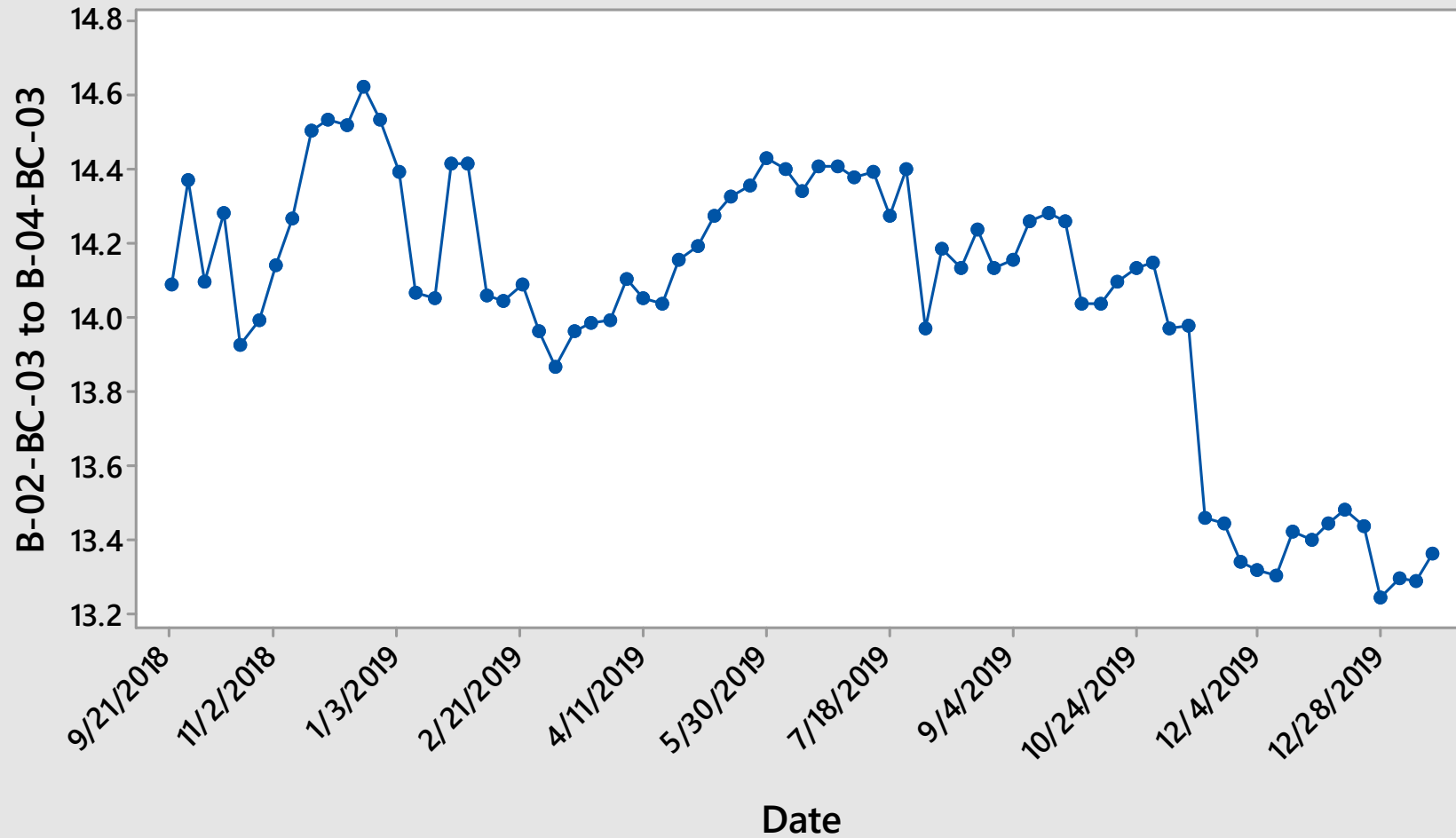


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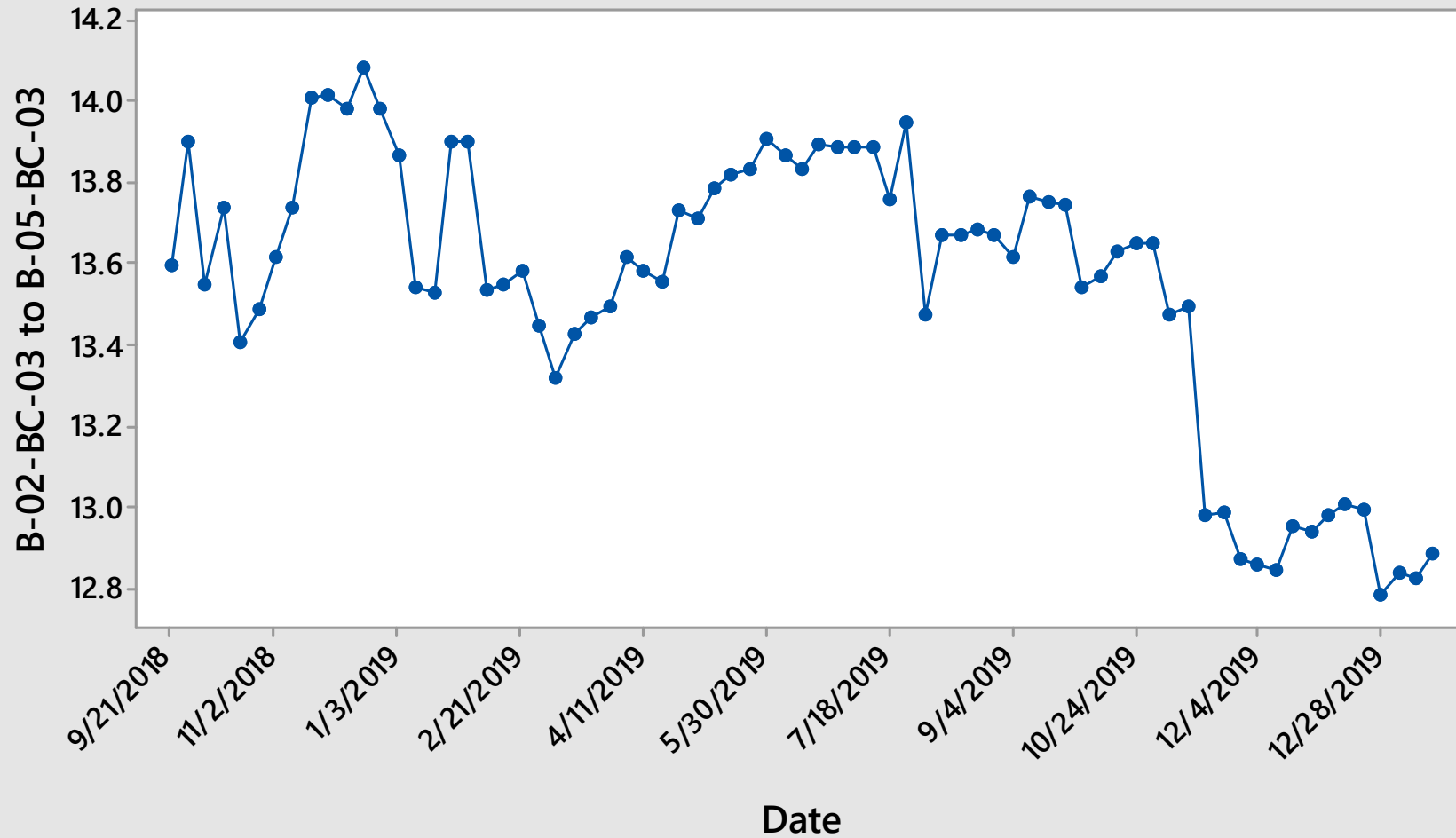




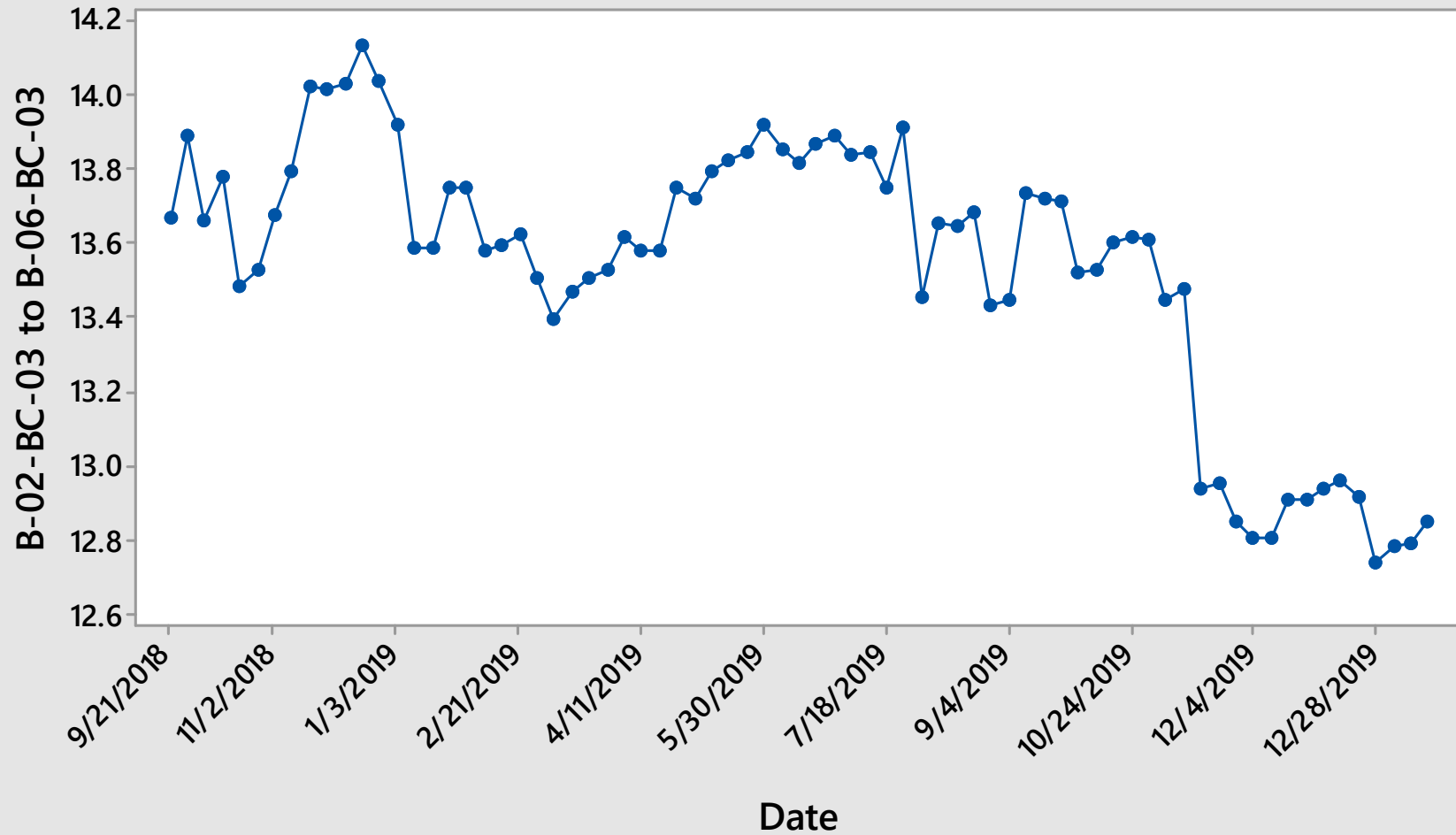
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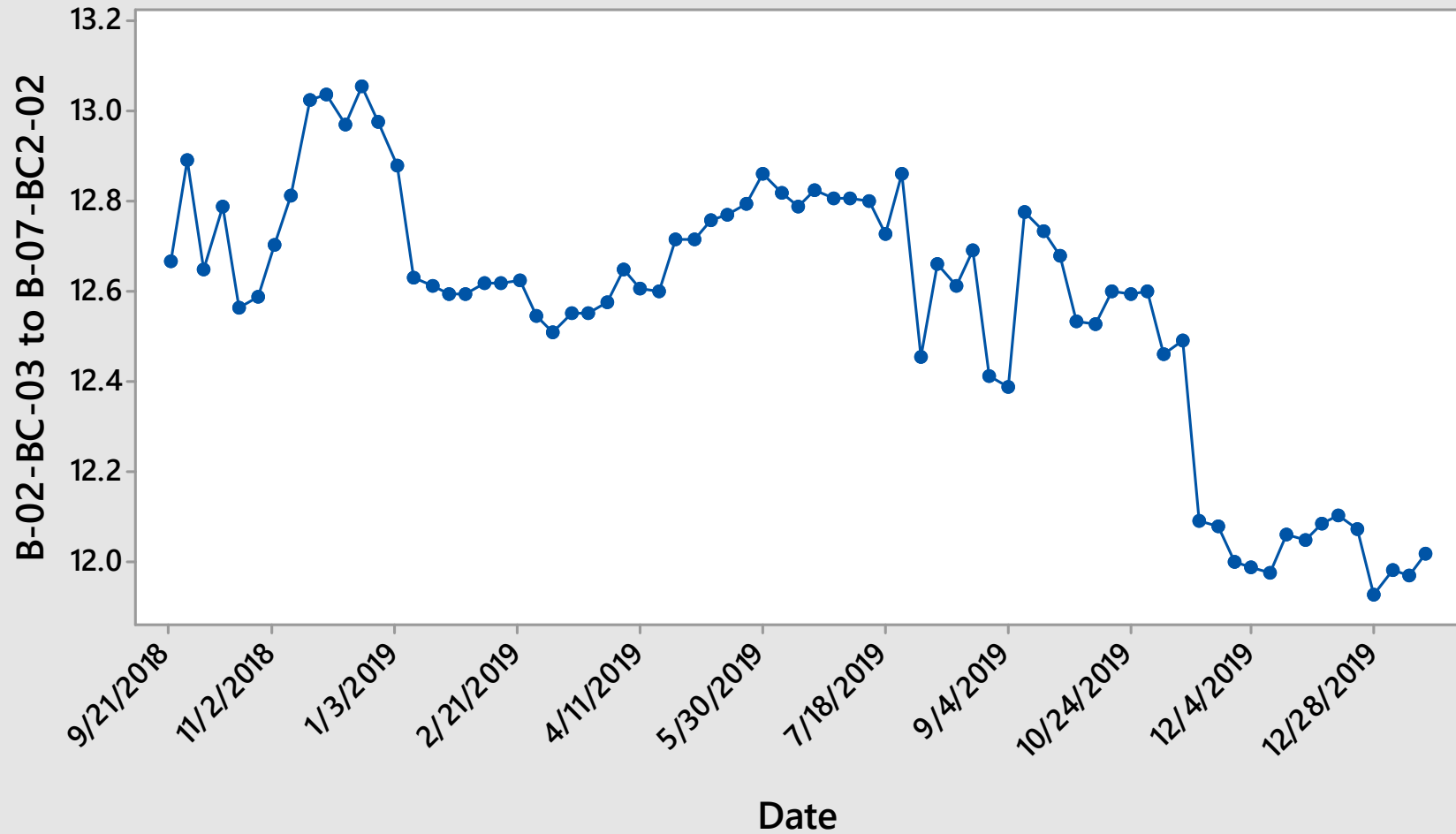
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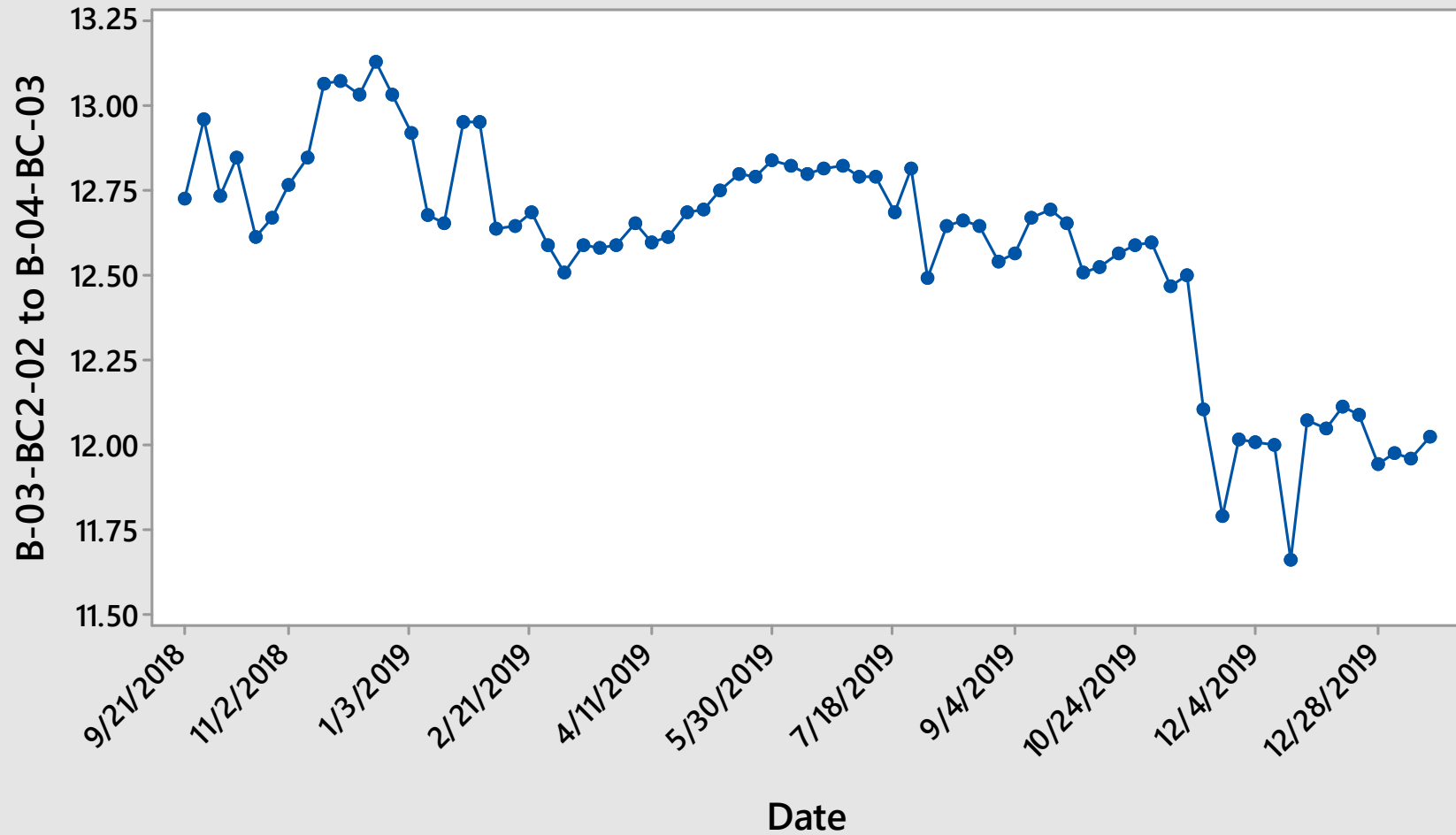
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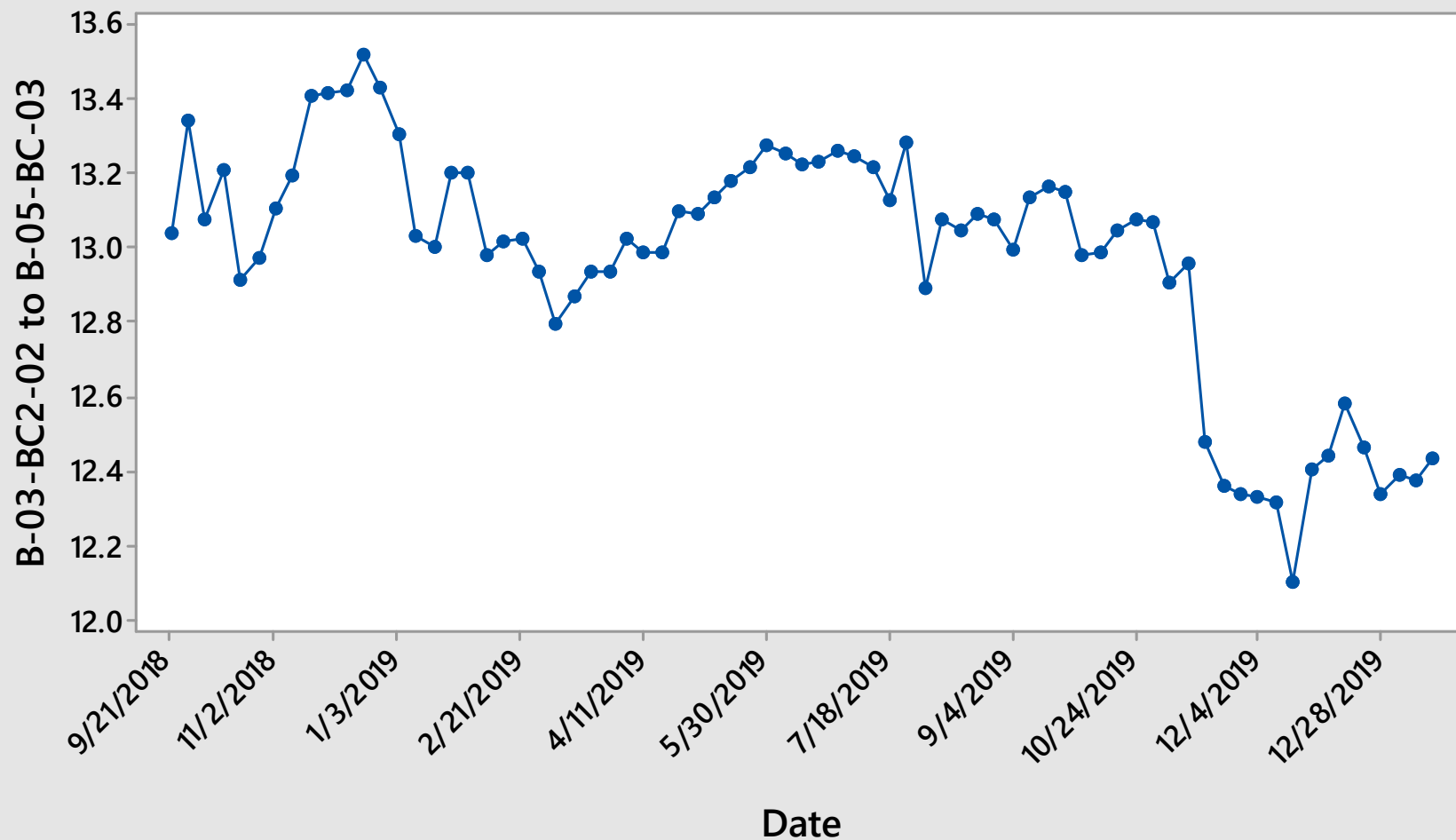


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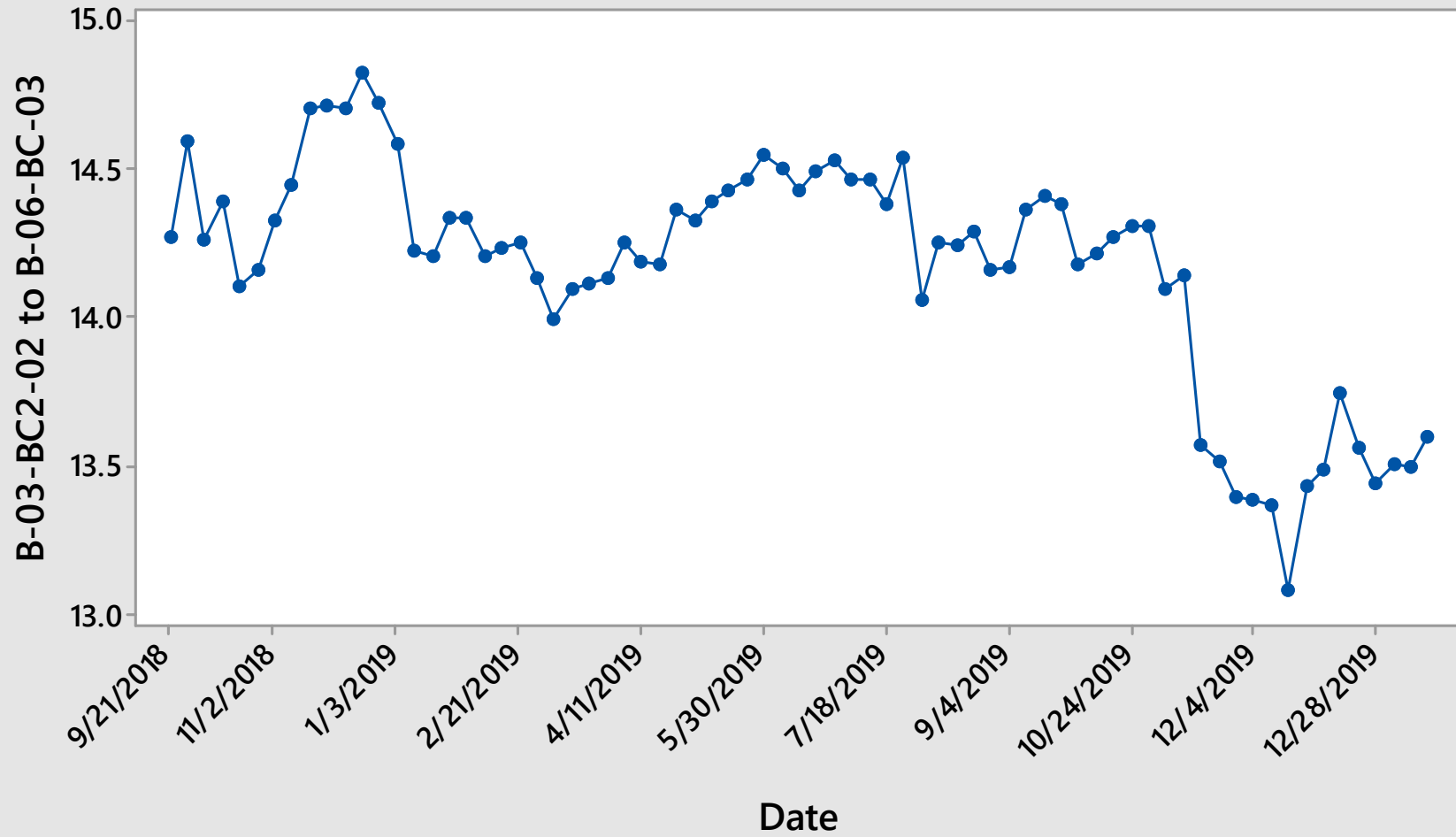




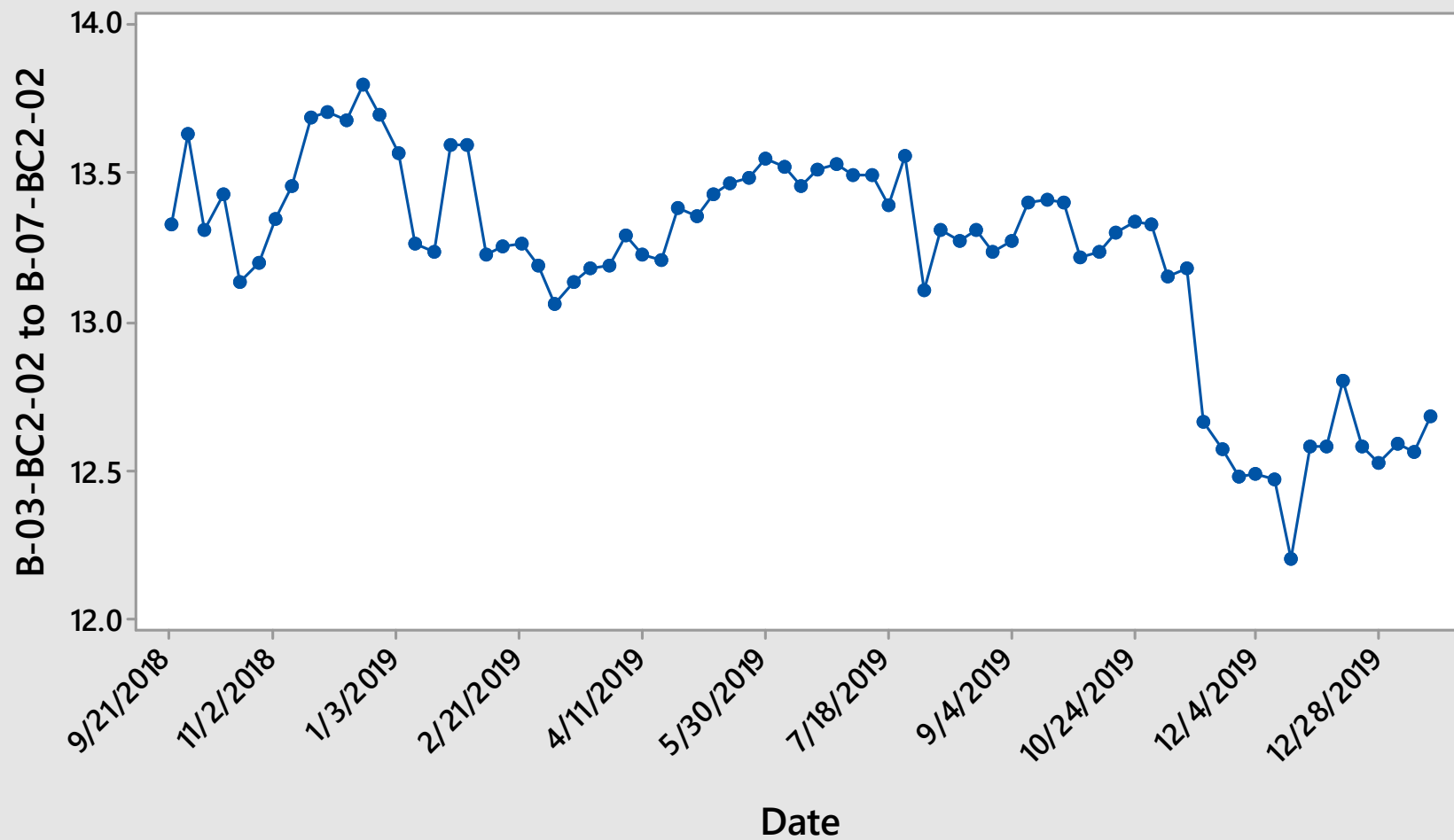
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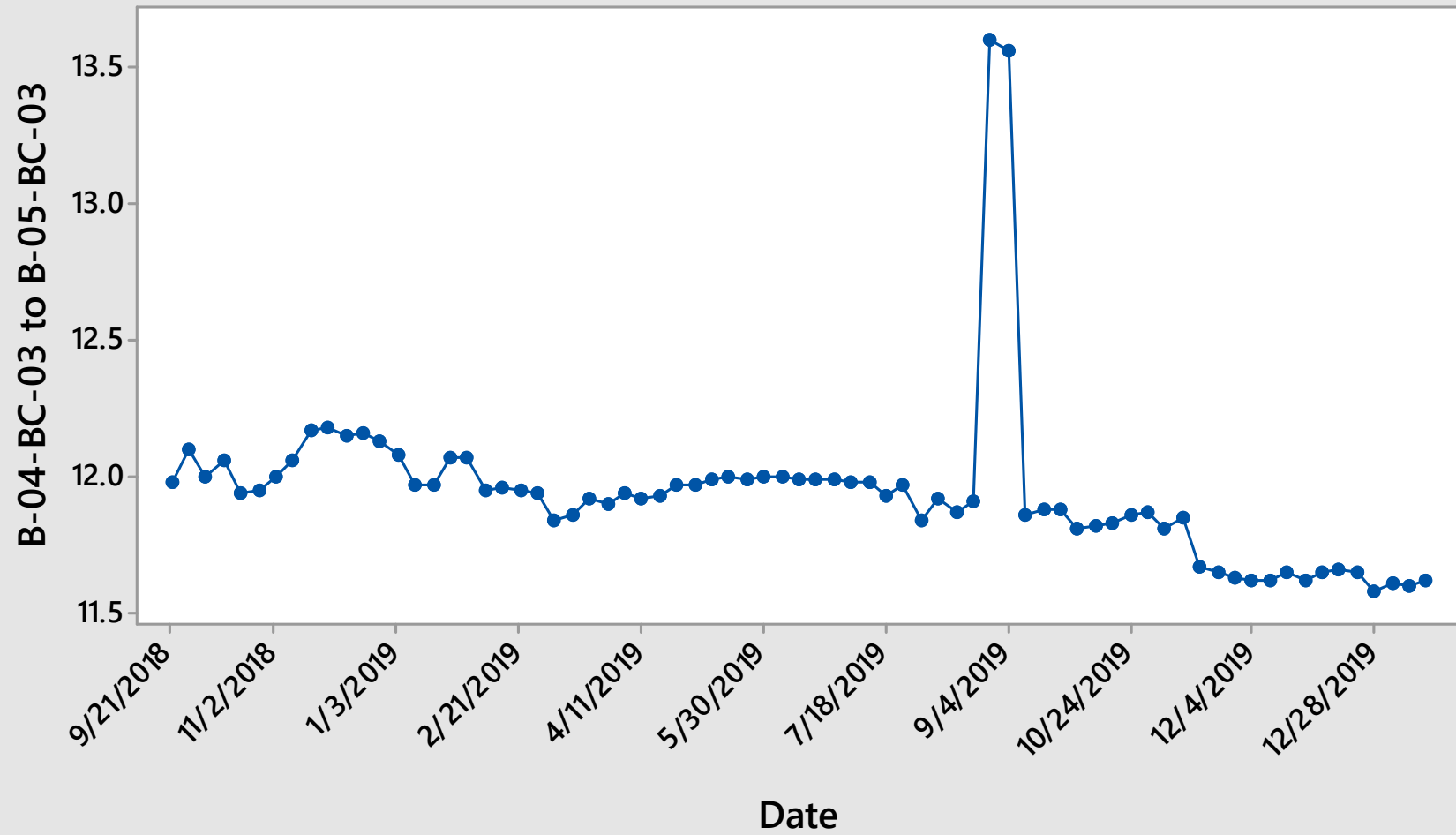
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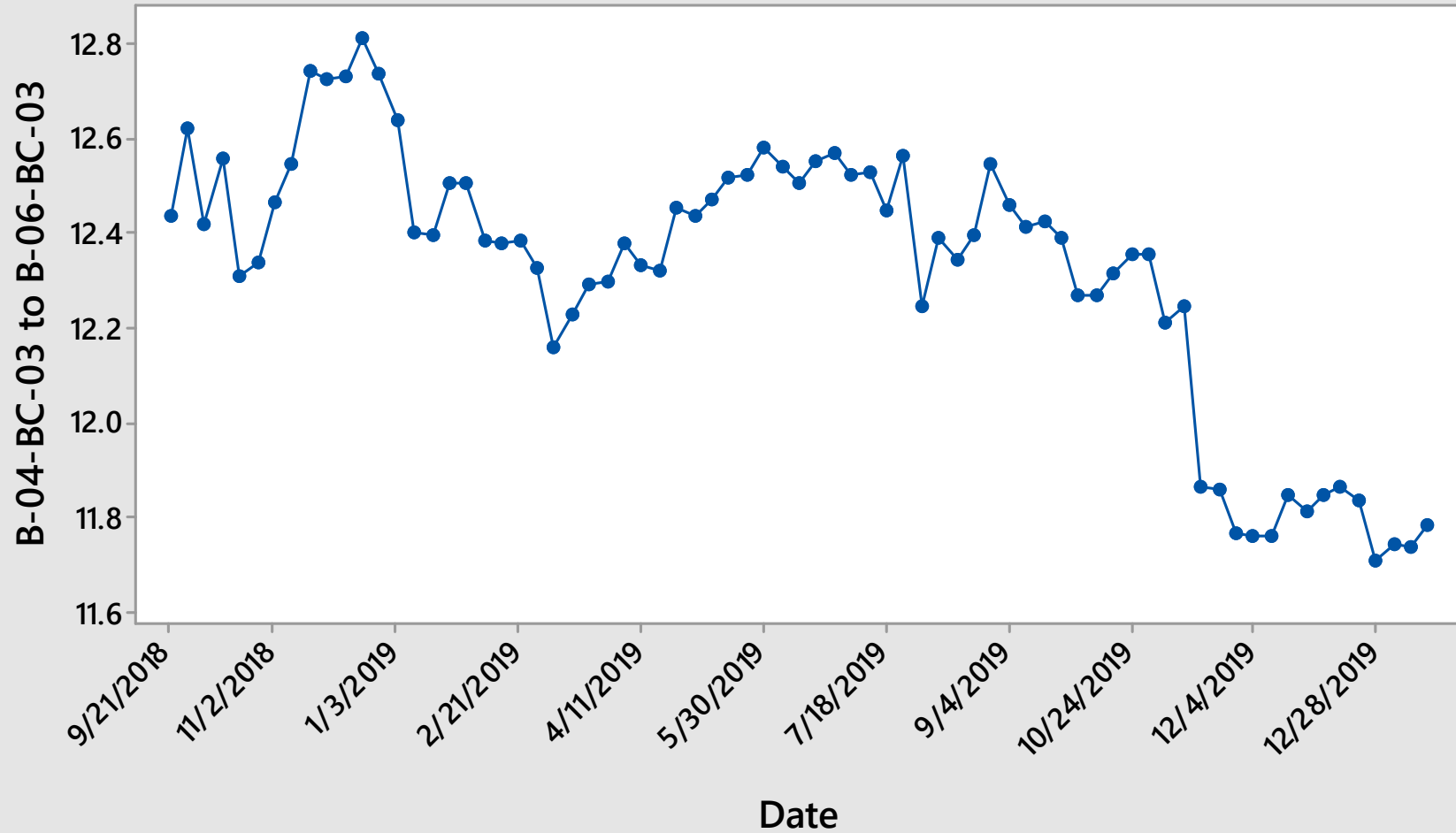
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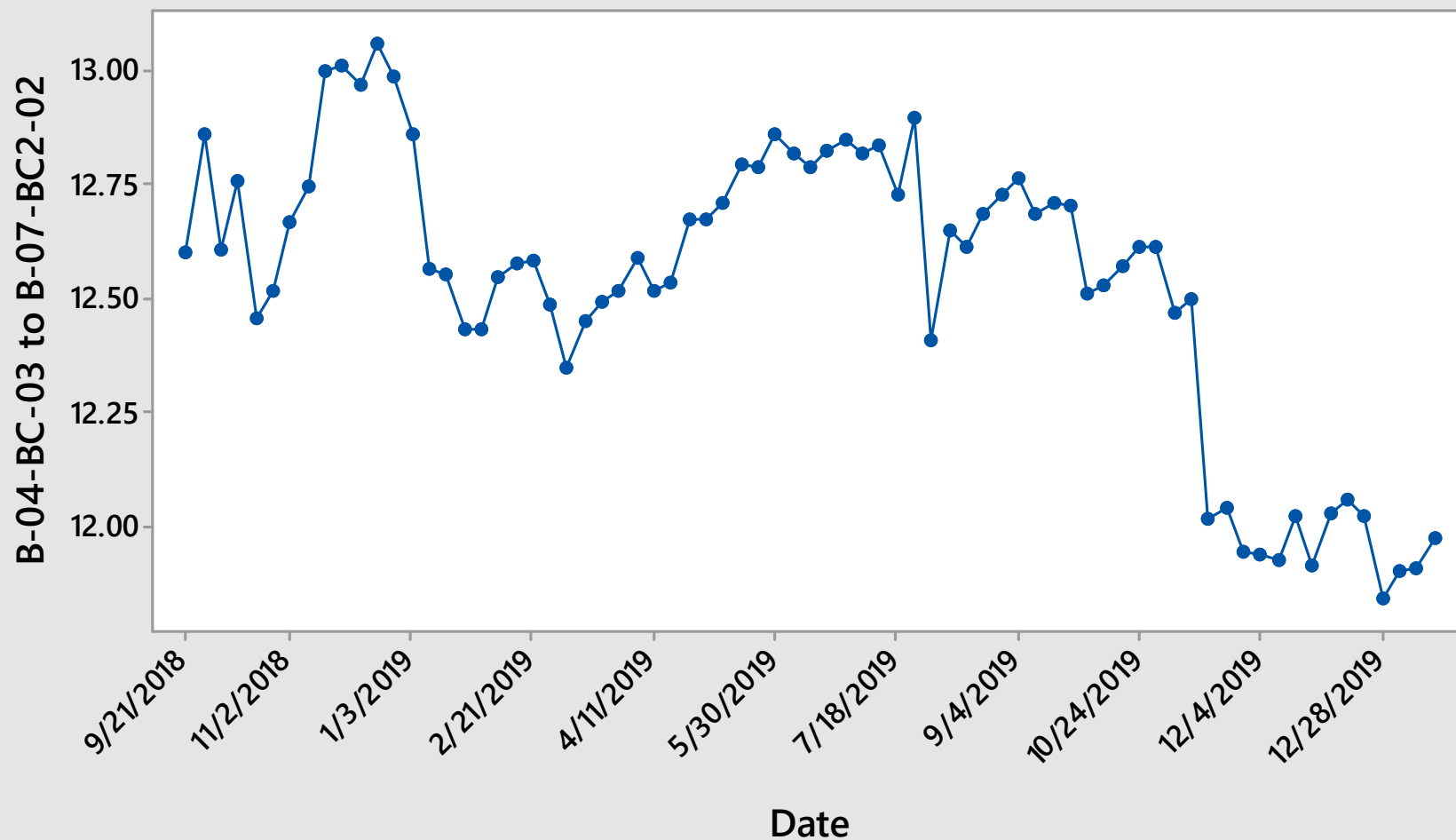


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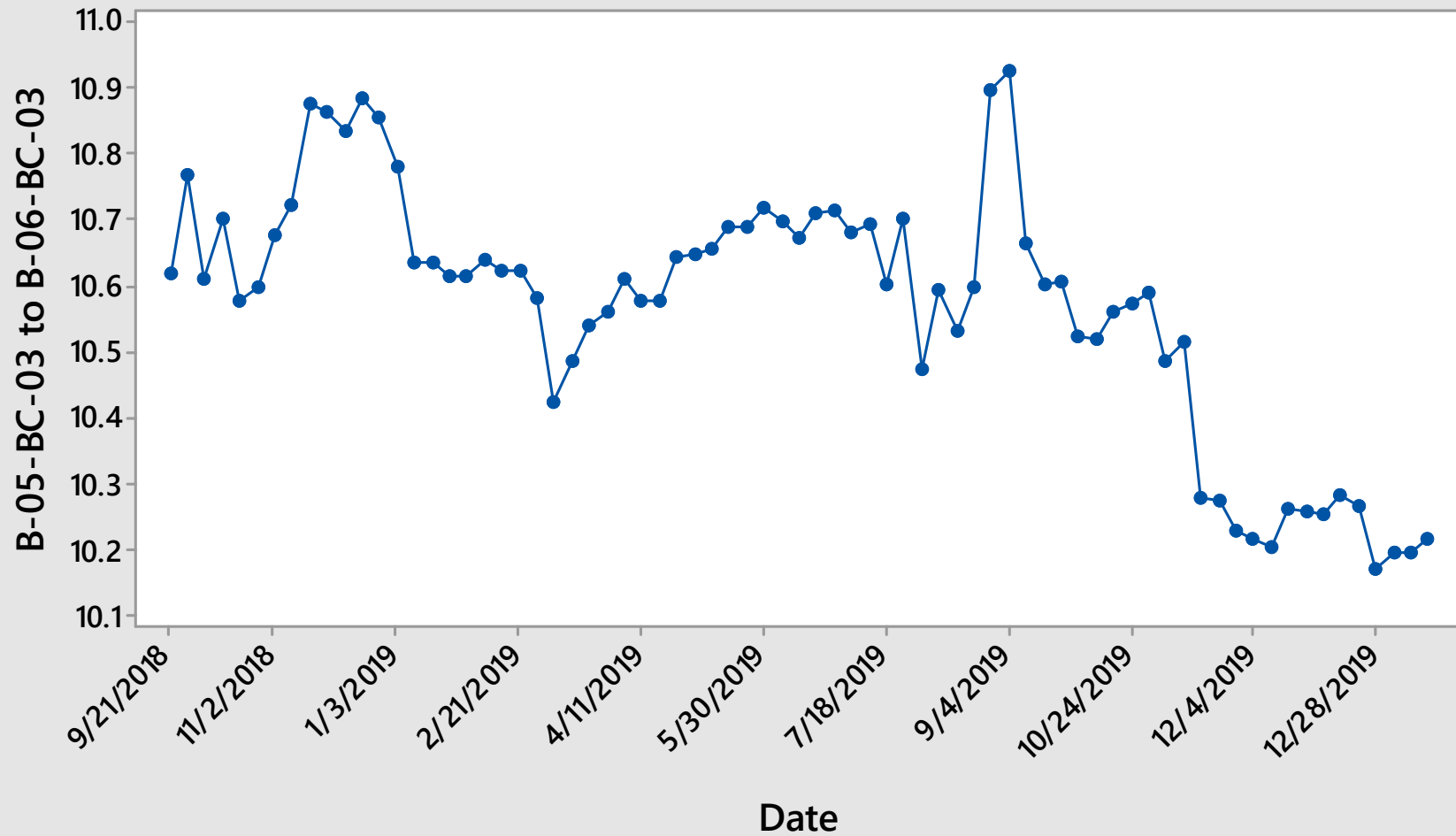




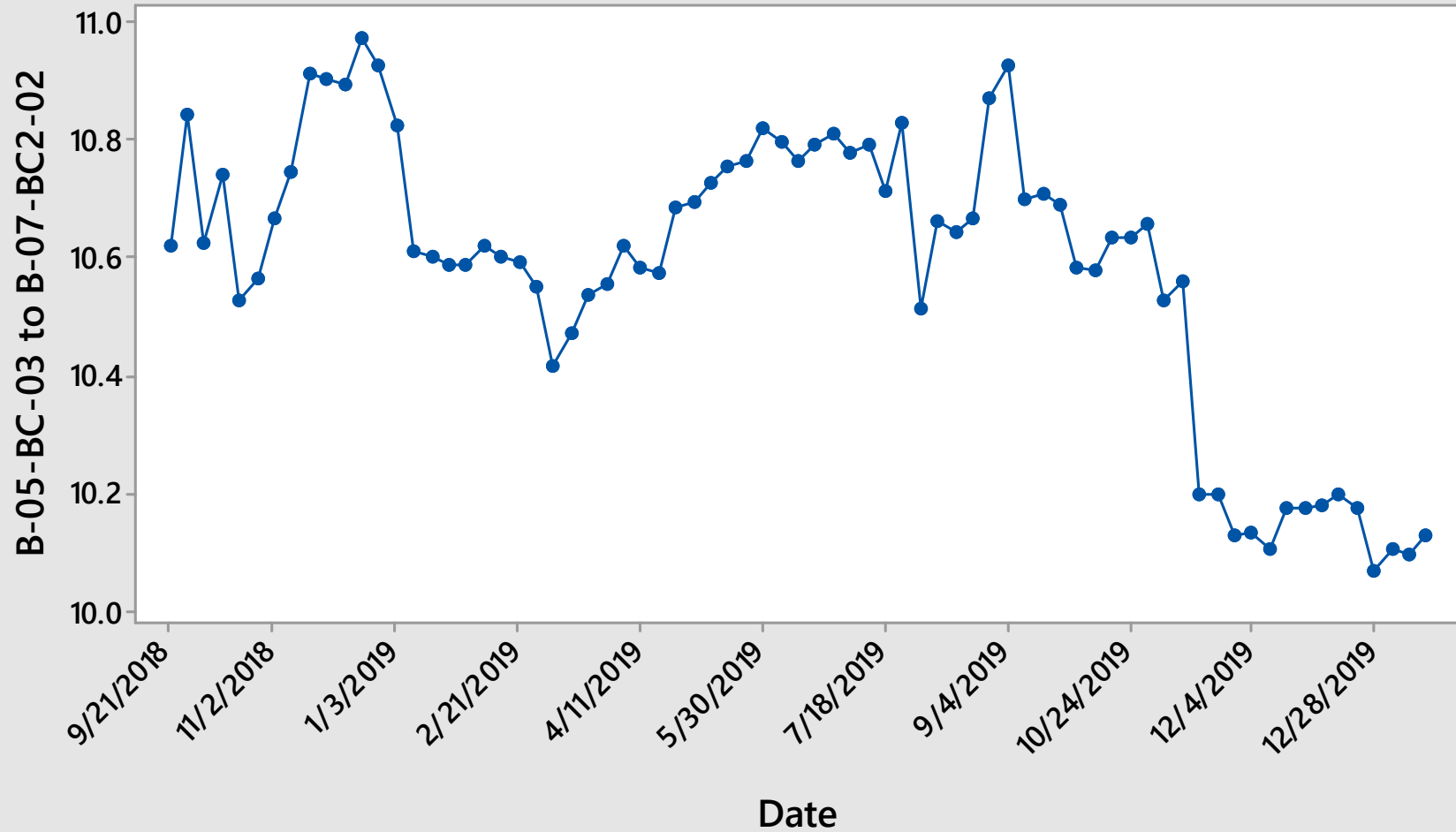
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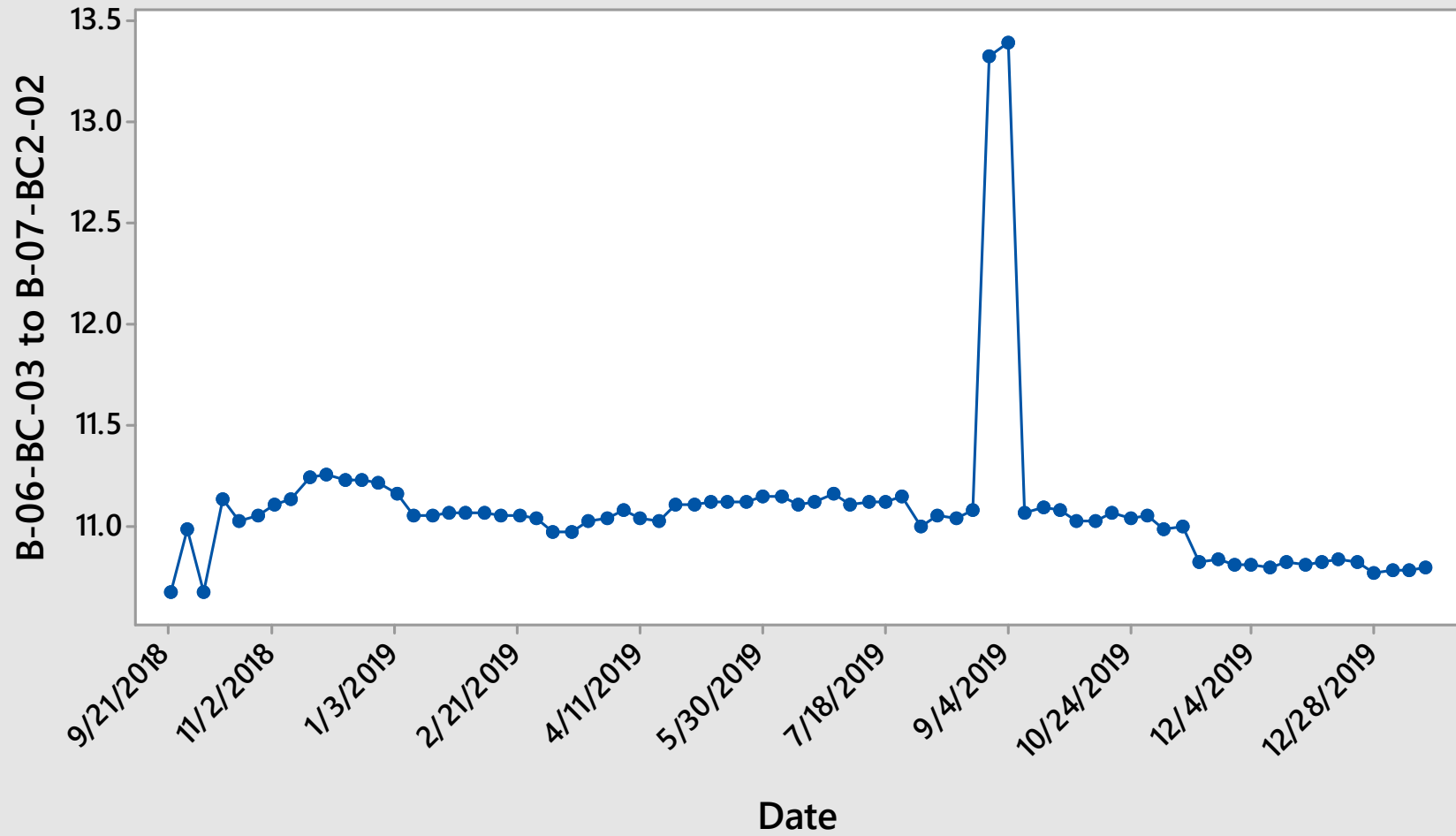
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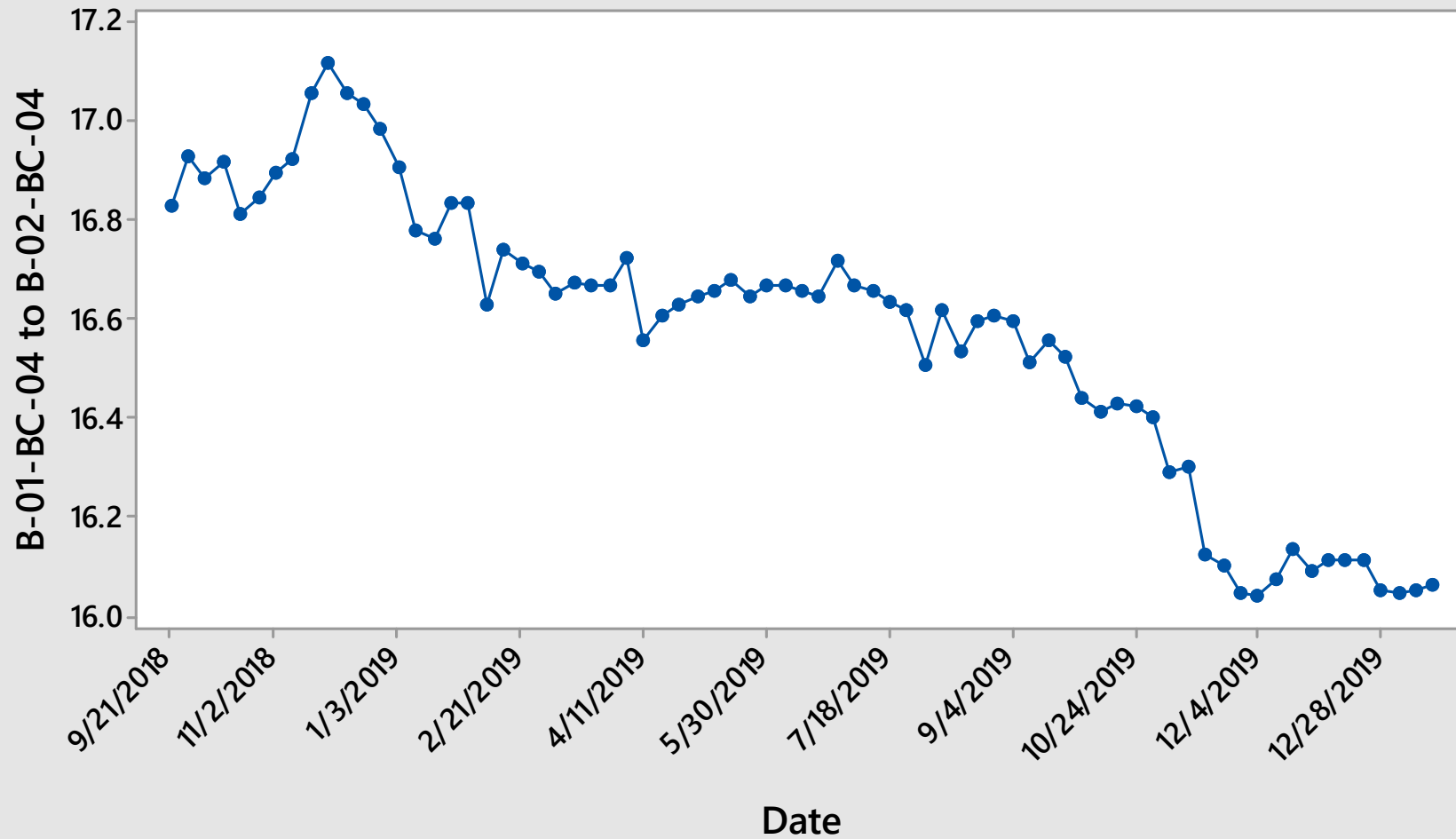
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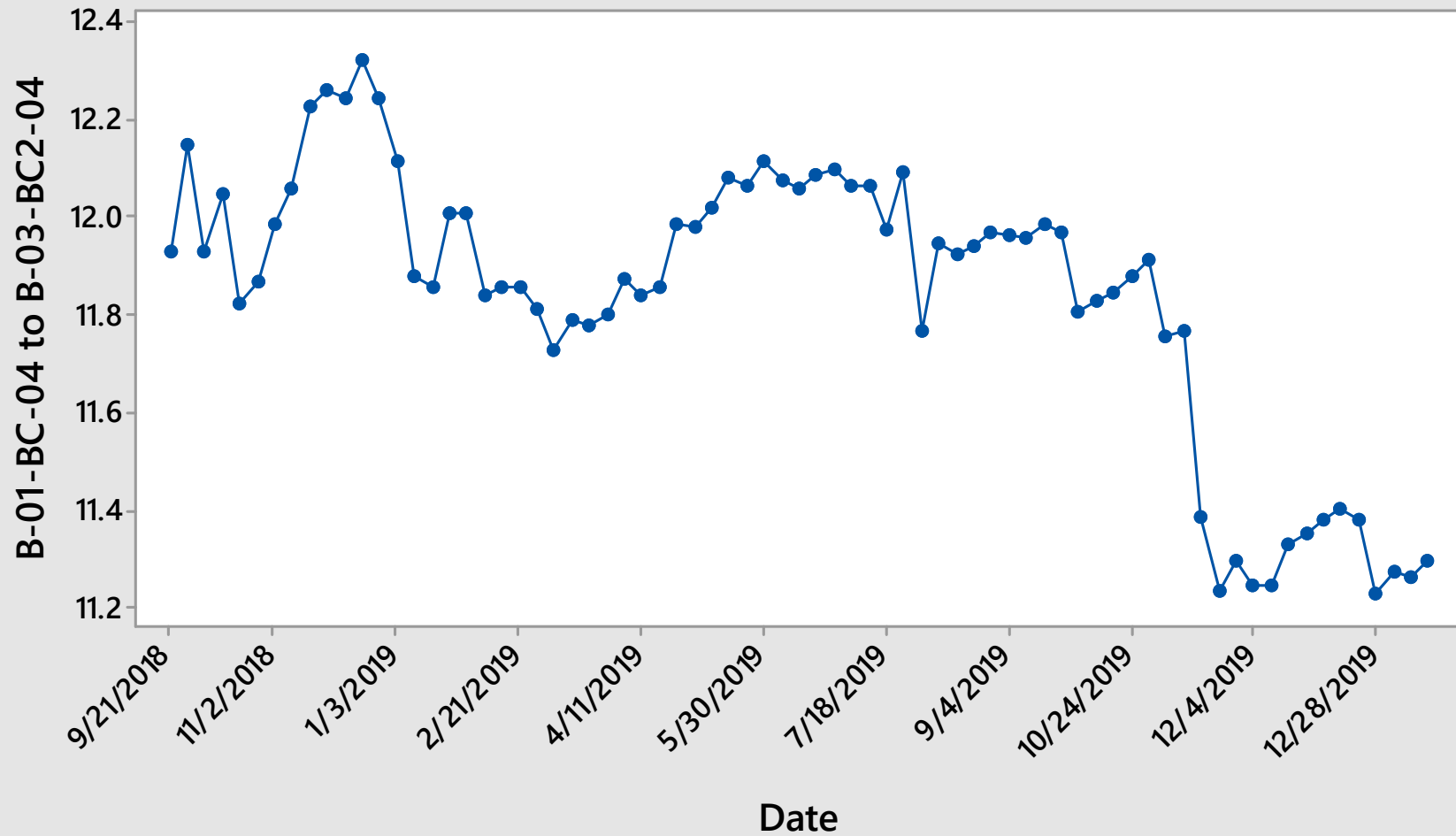


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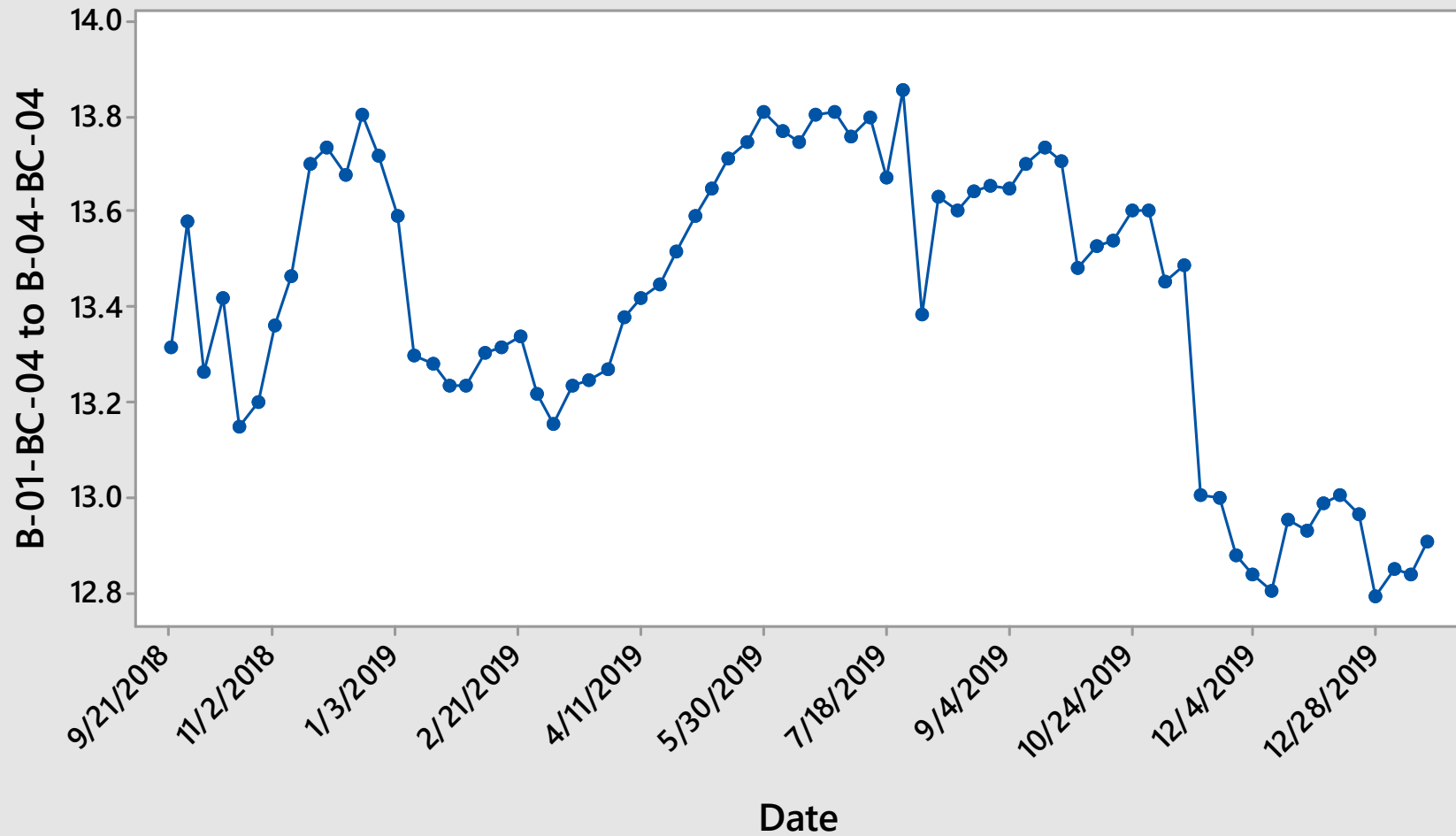




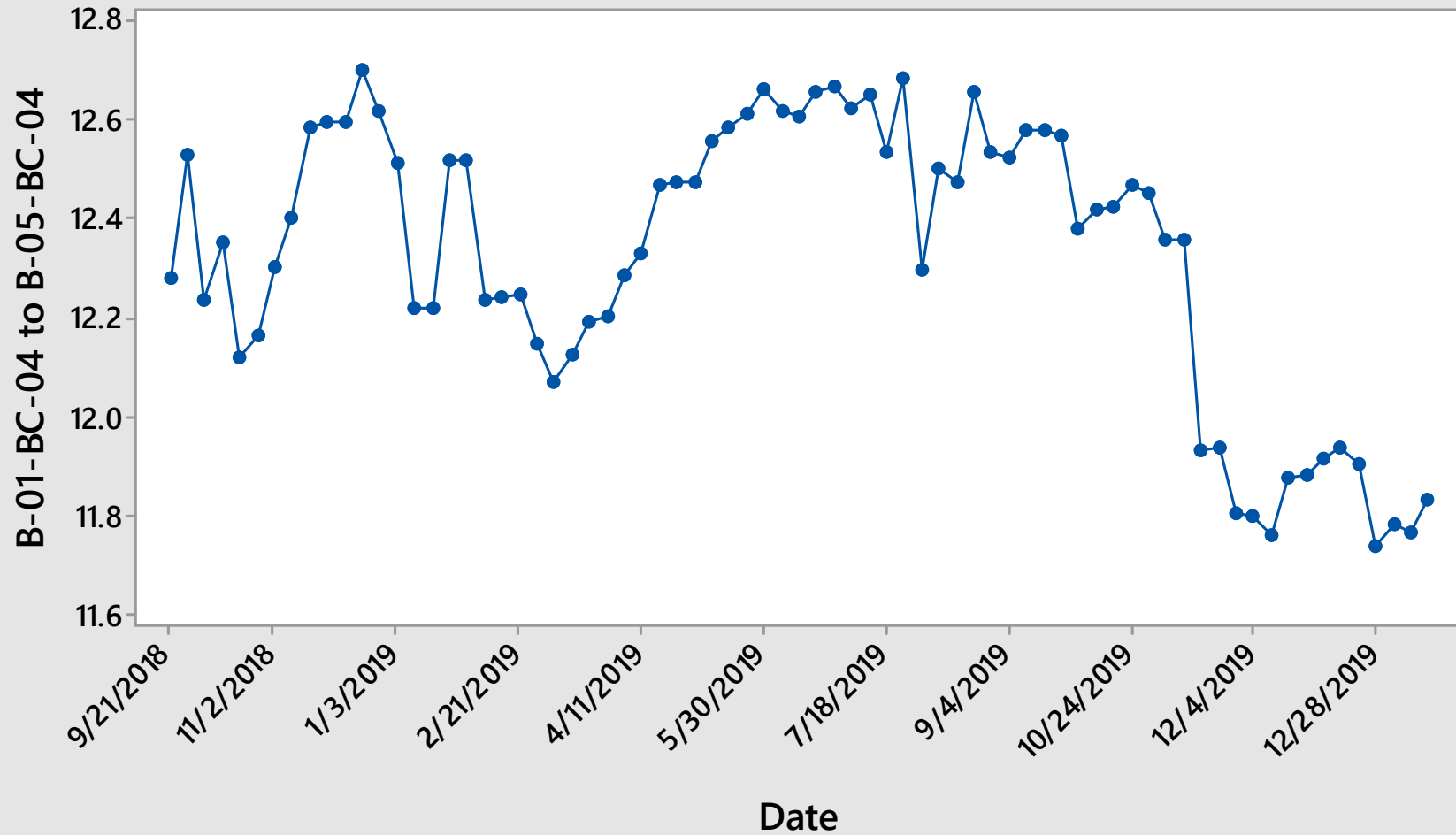
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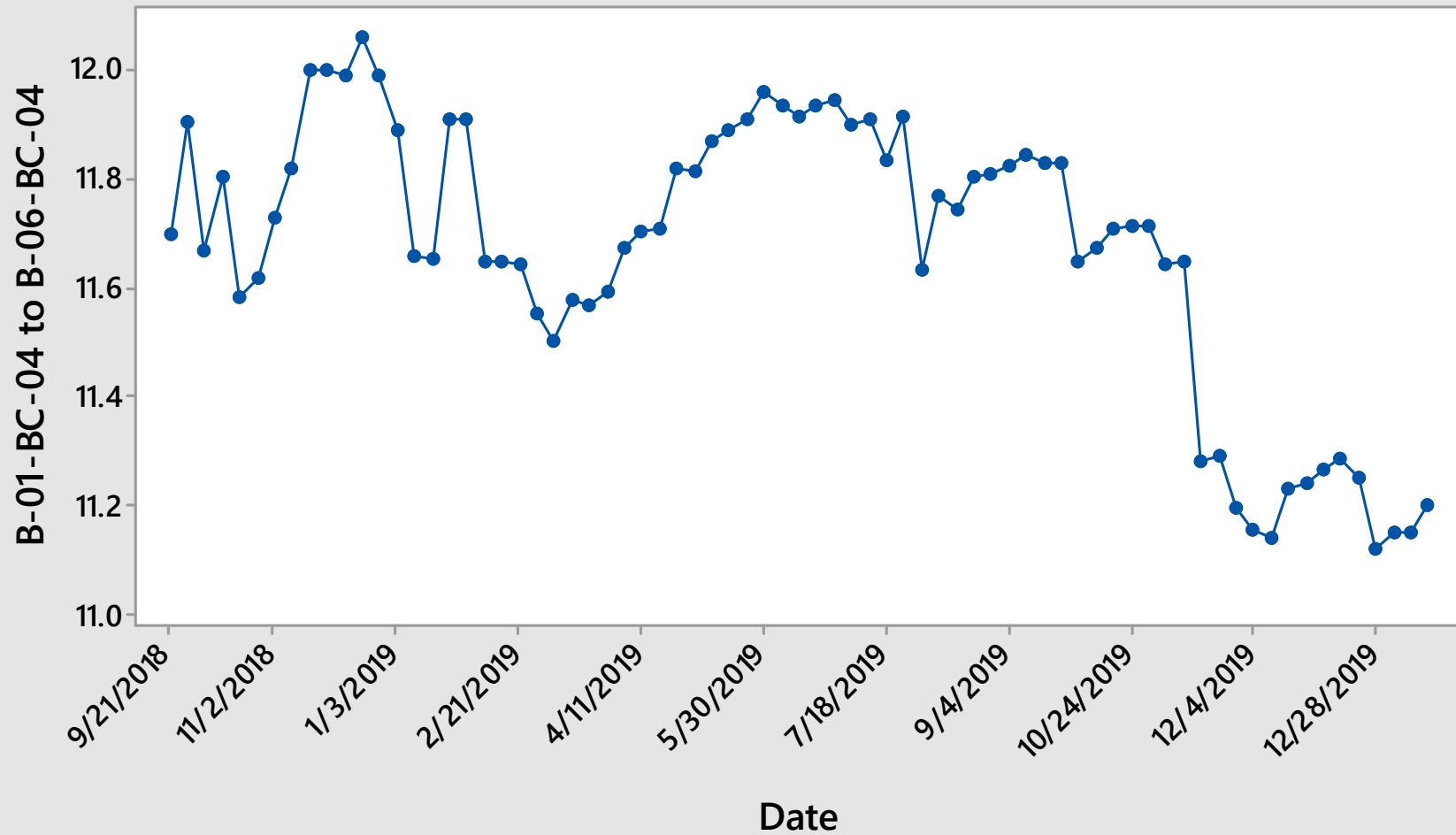
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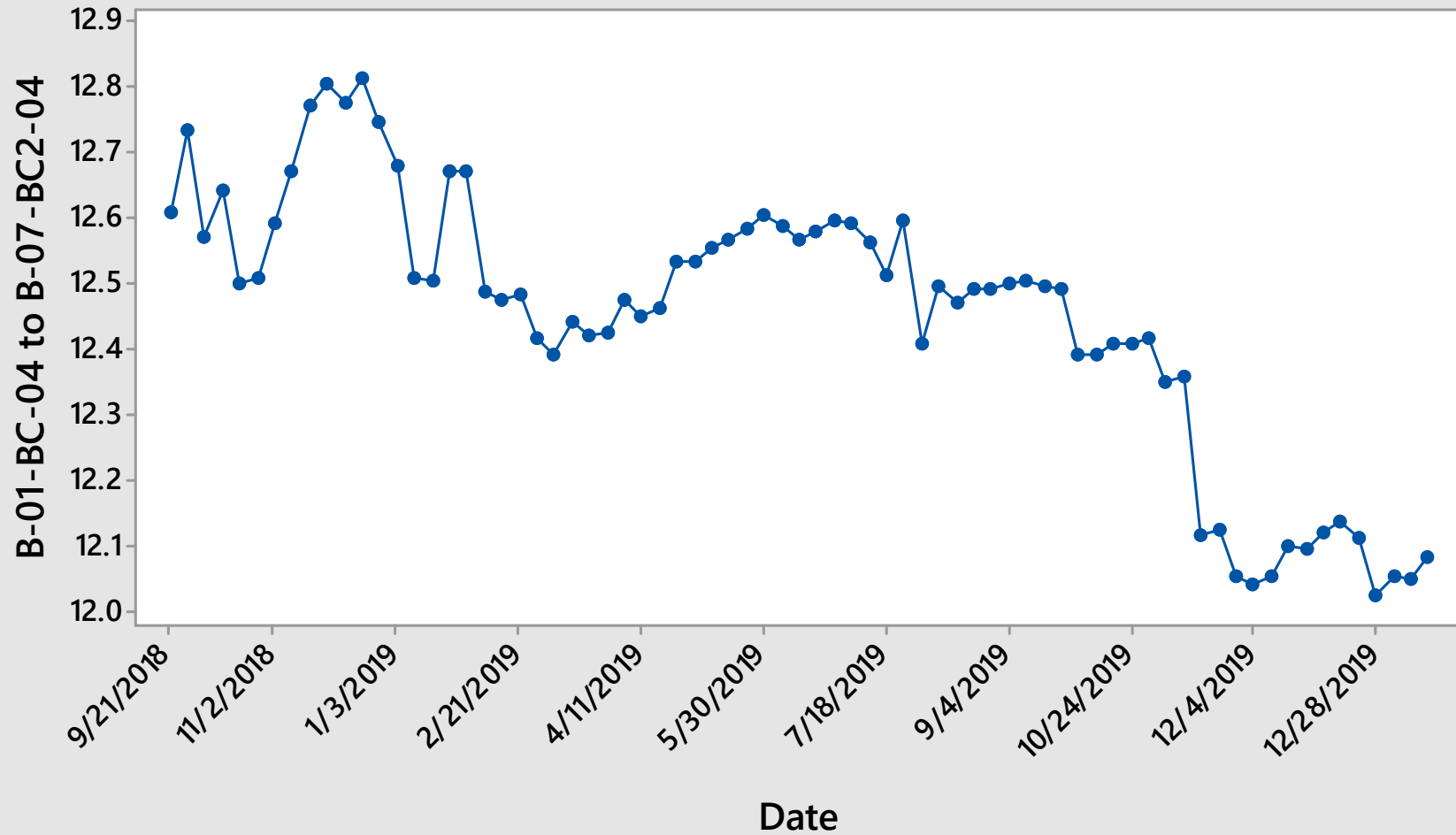
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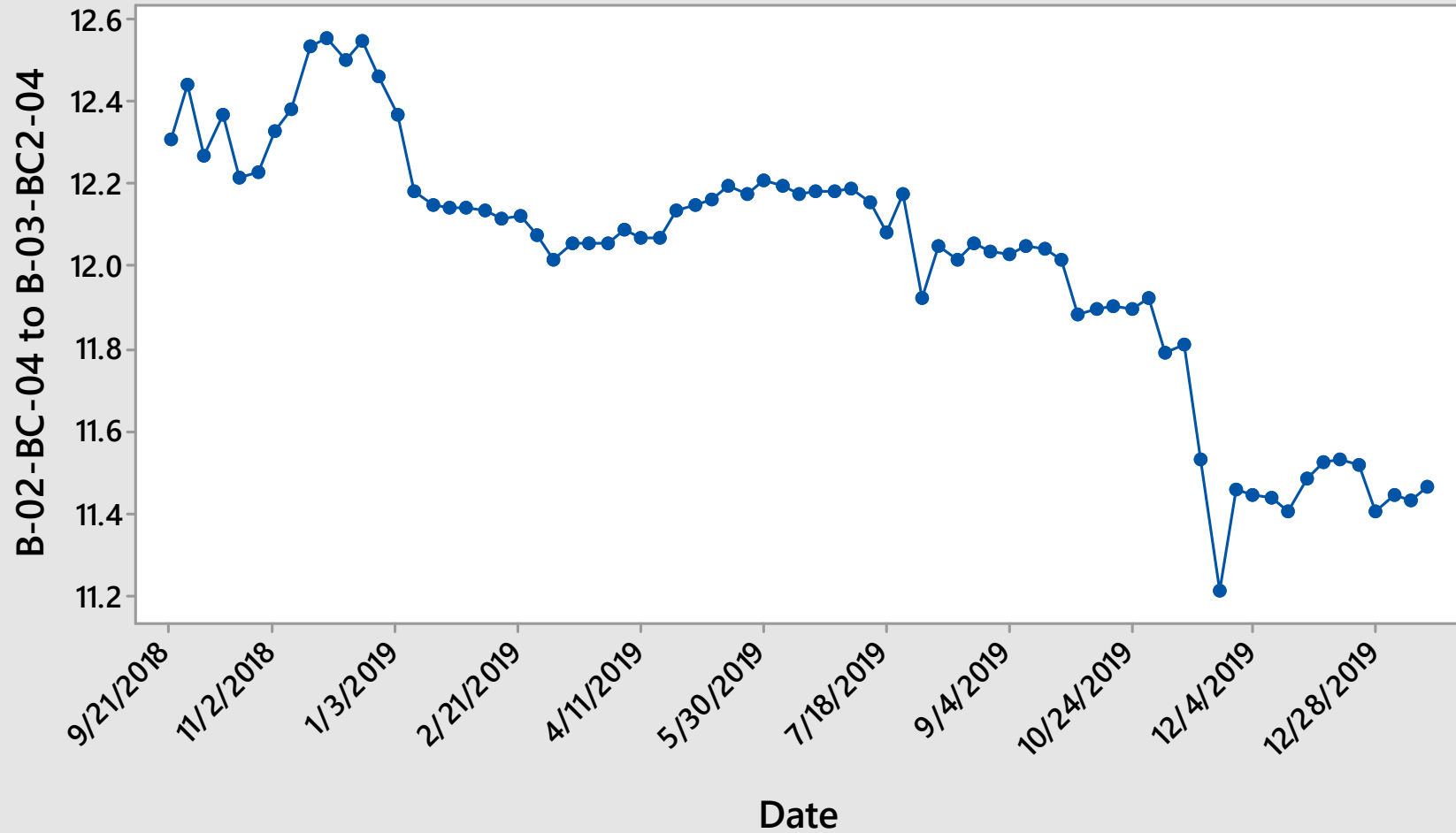
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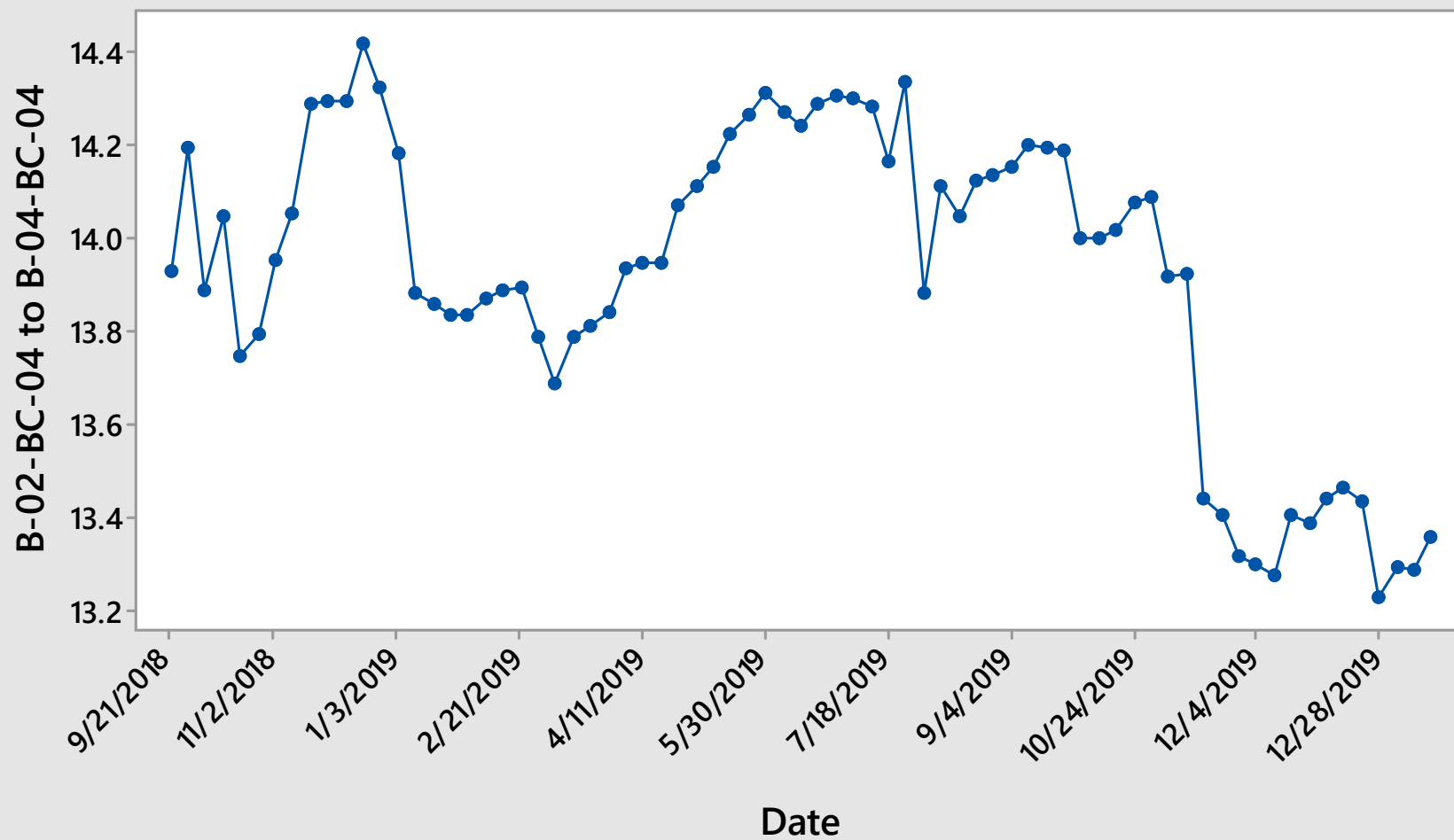


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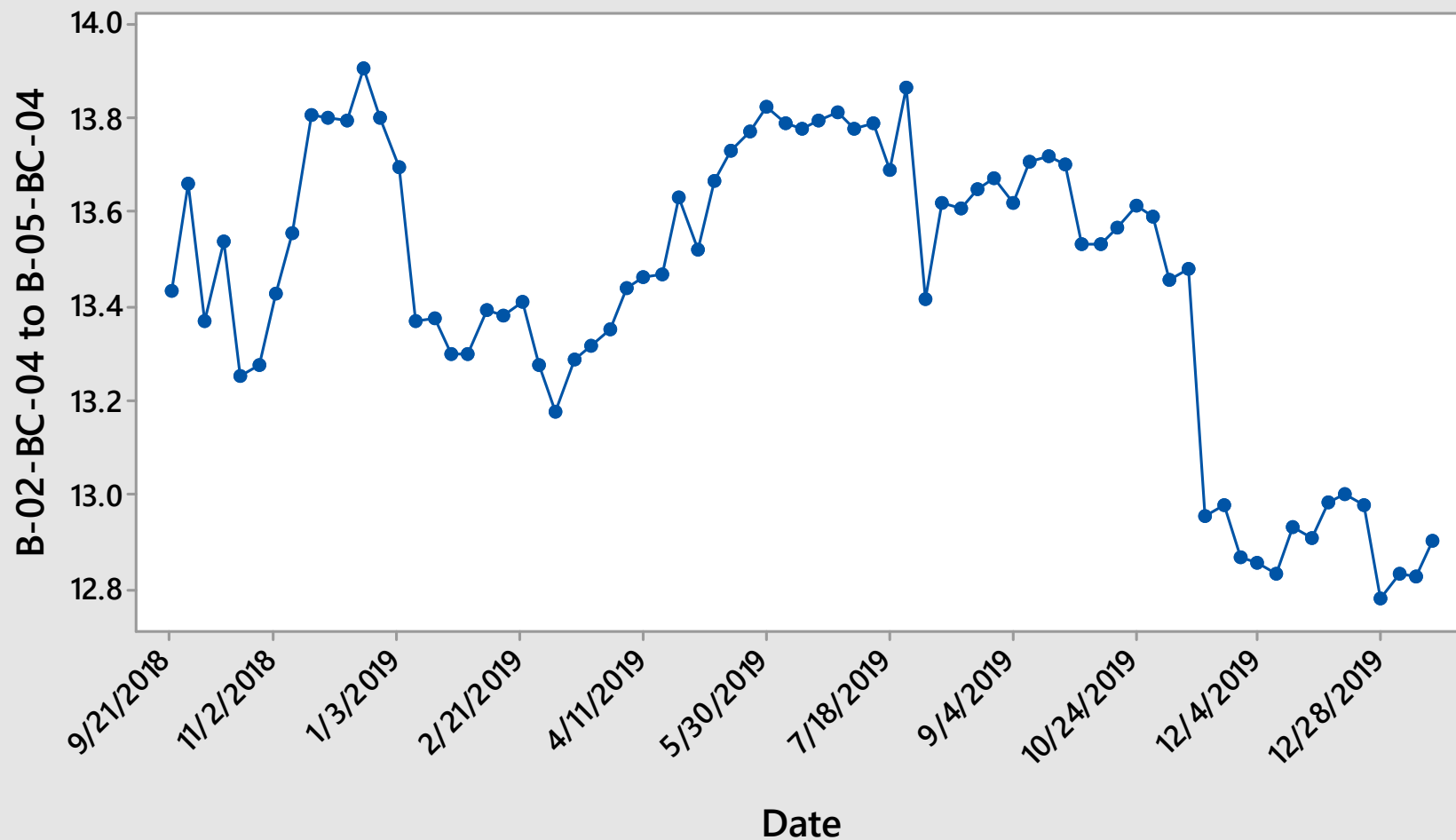




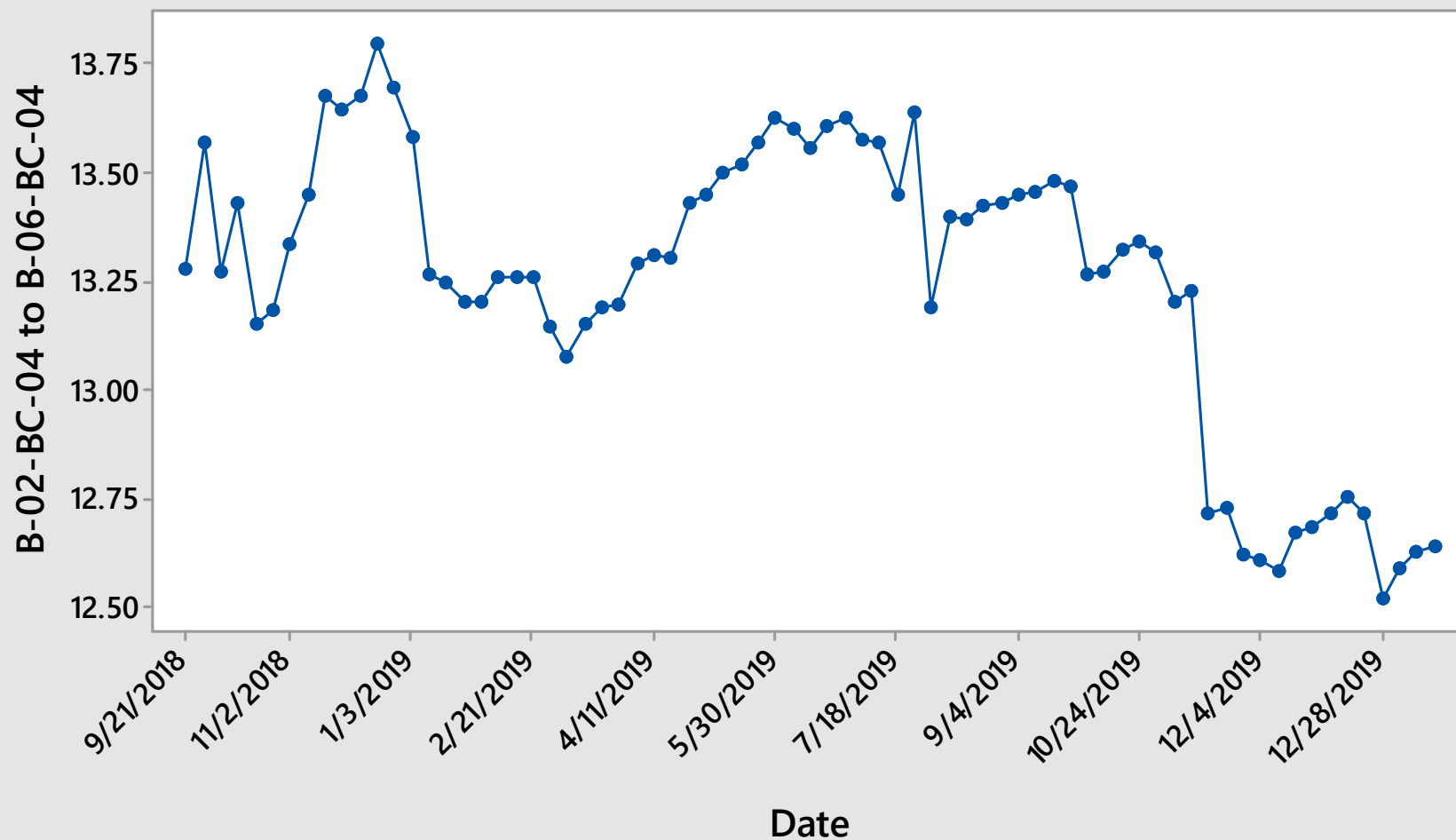
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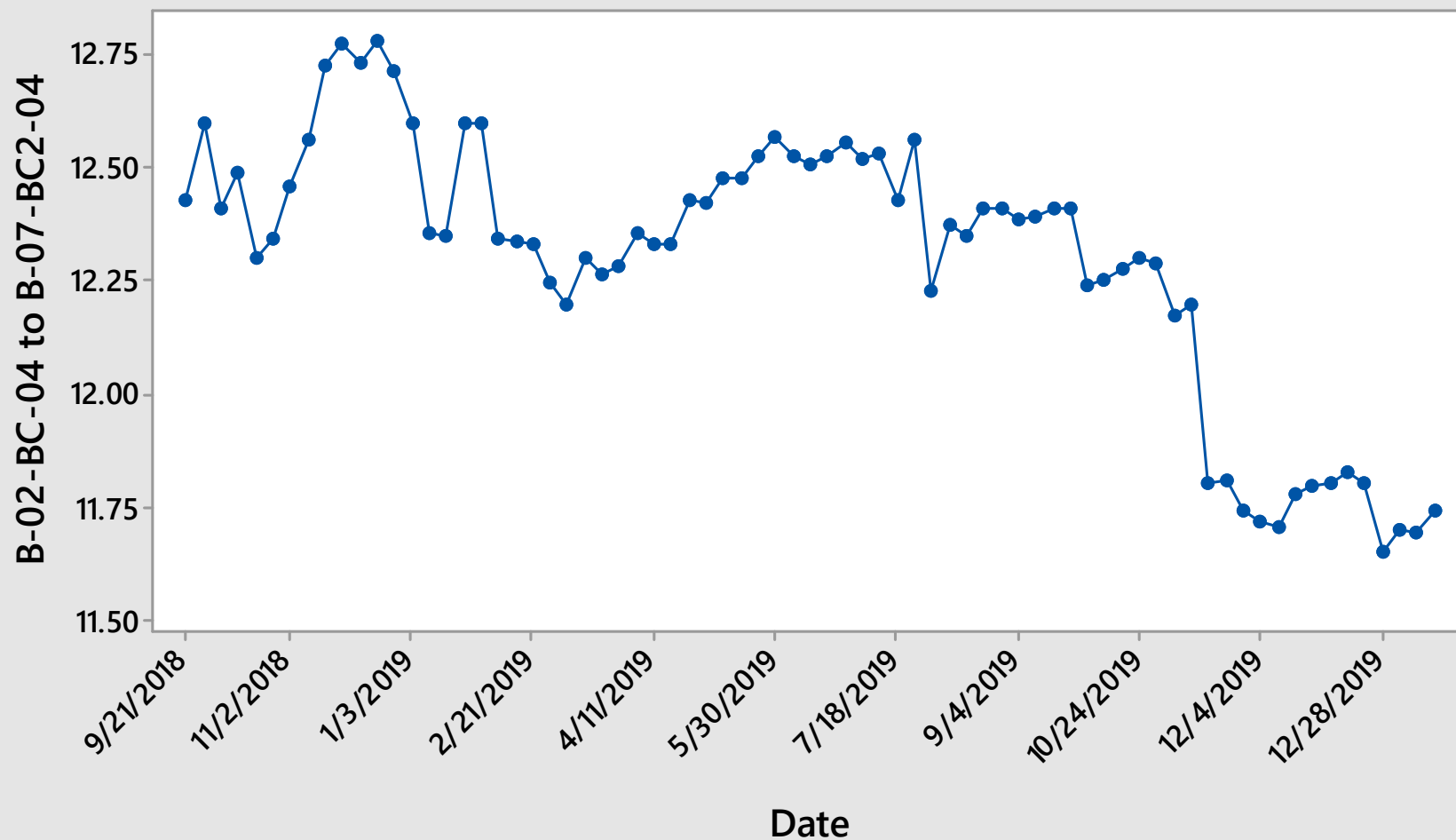
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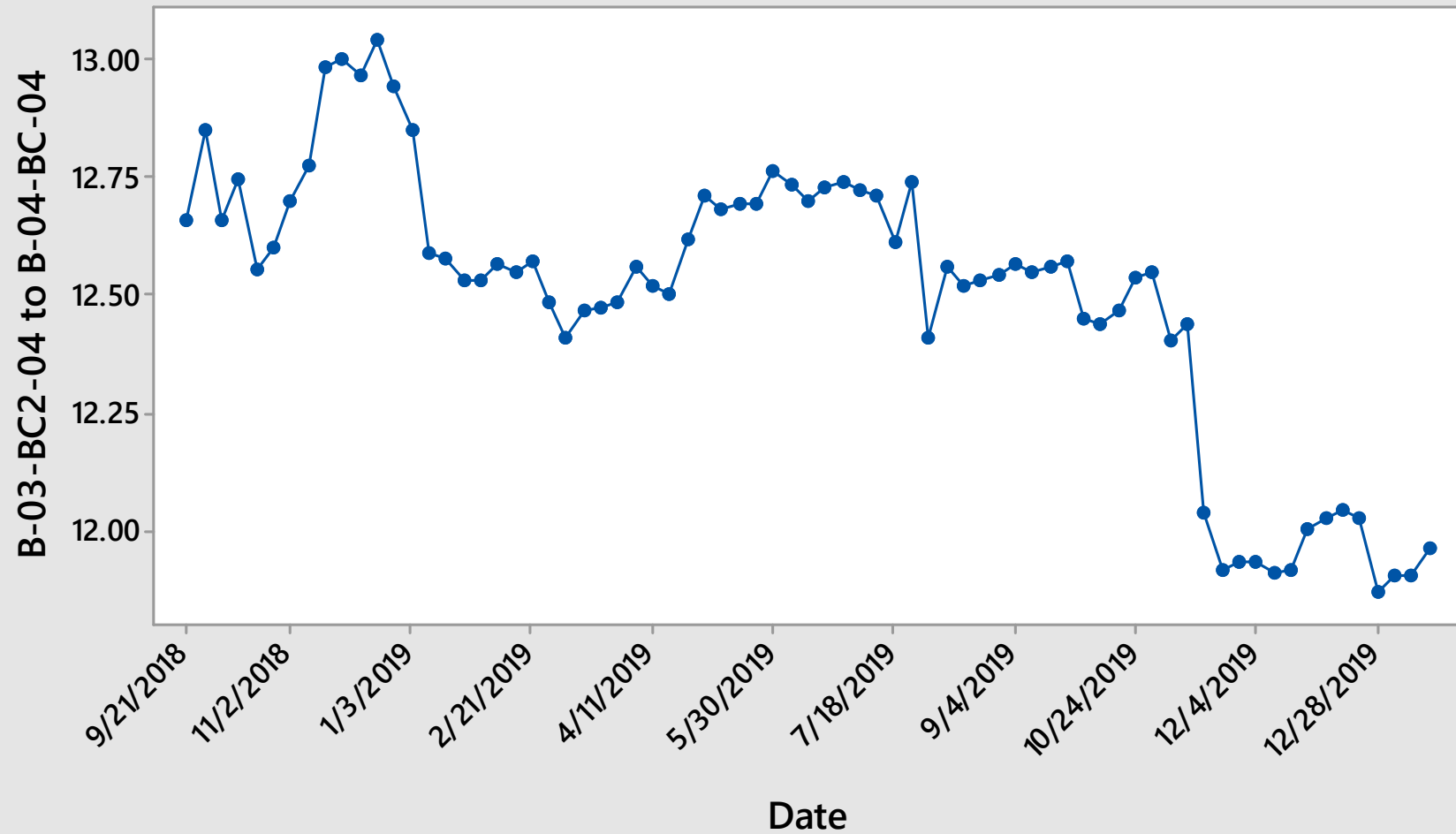
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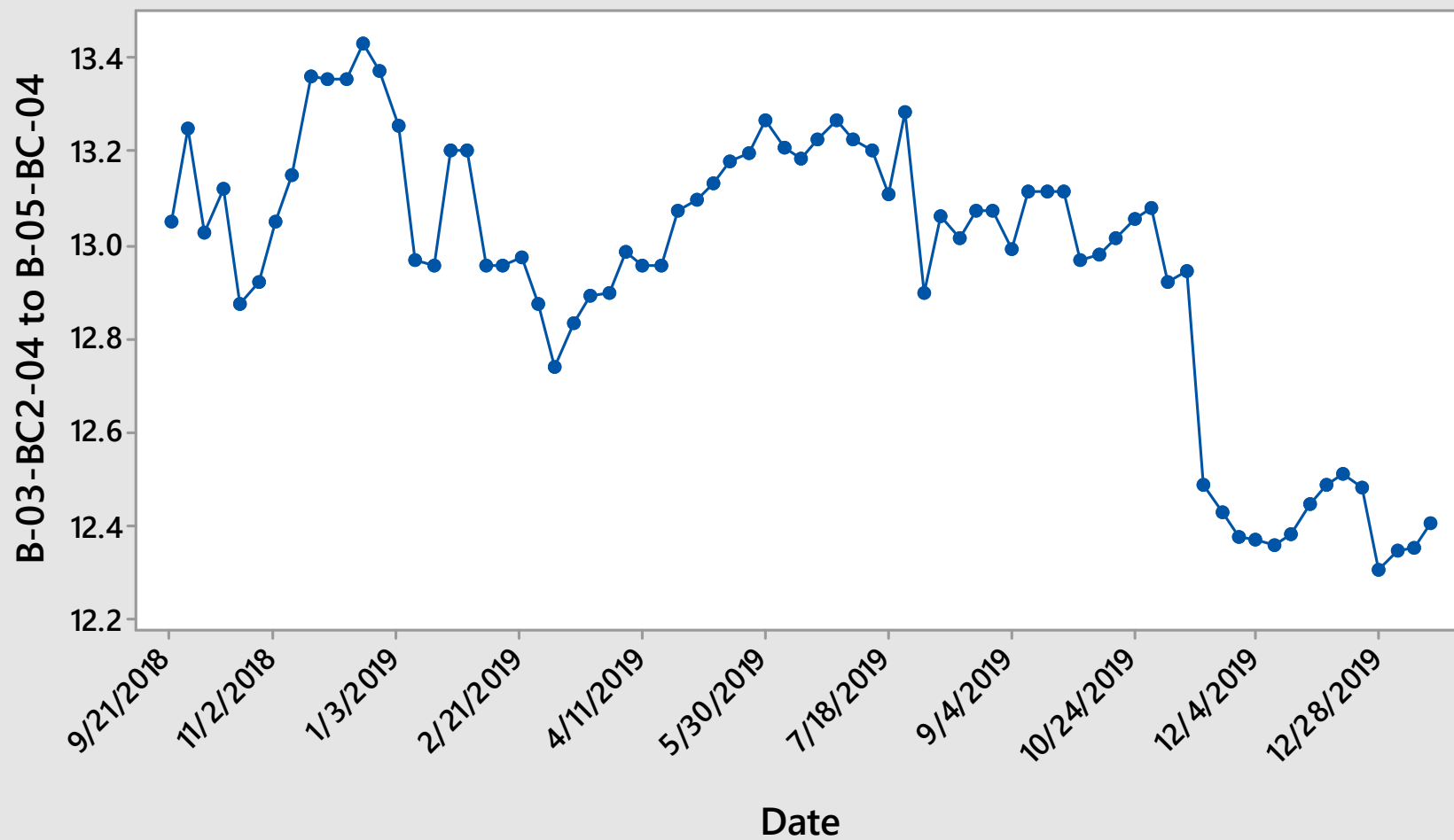
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Time Series Plot of B-03-BC2-04 to B-04-BC-04  
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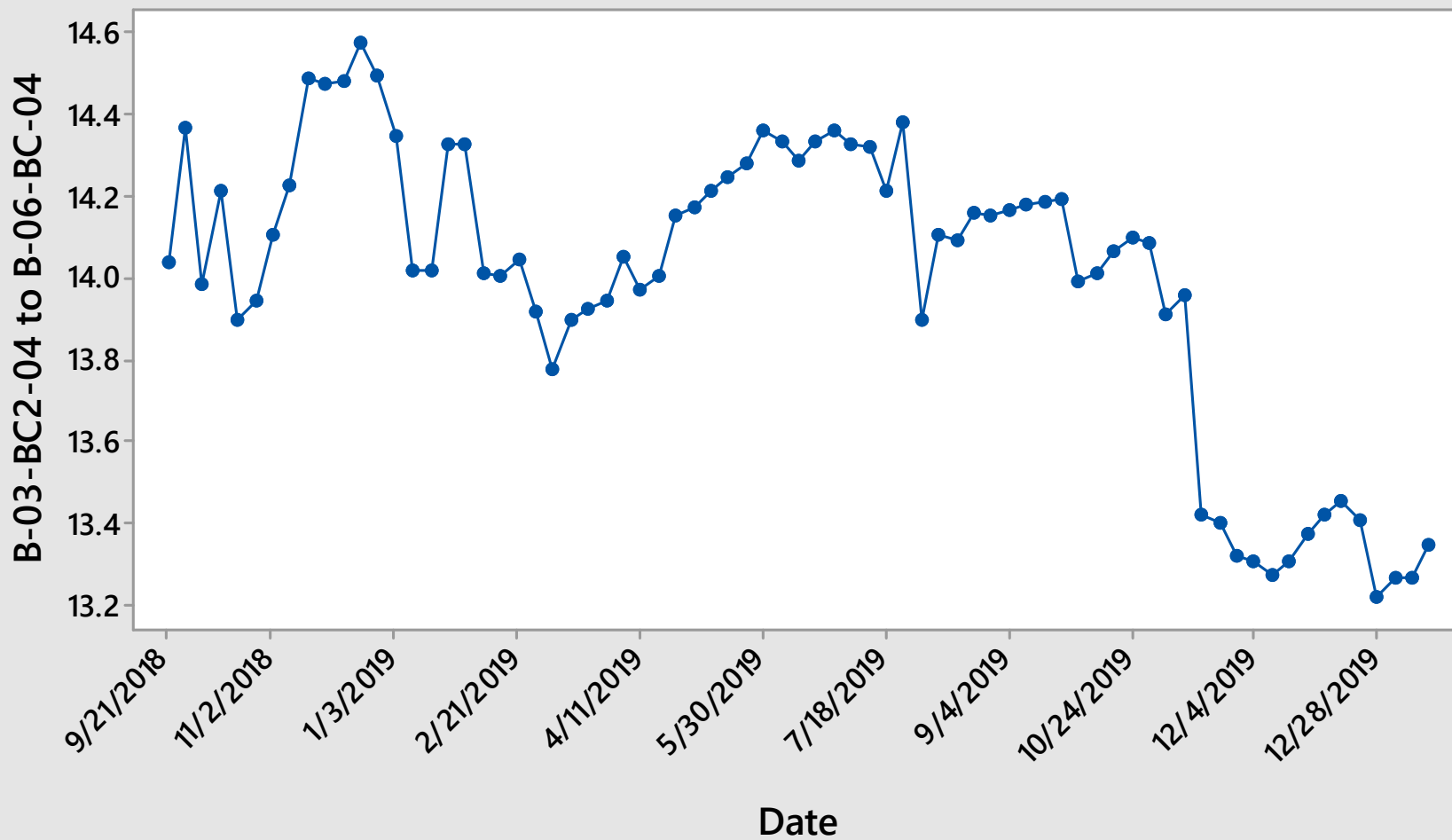


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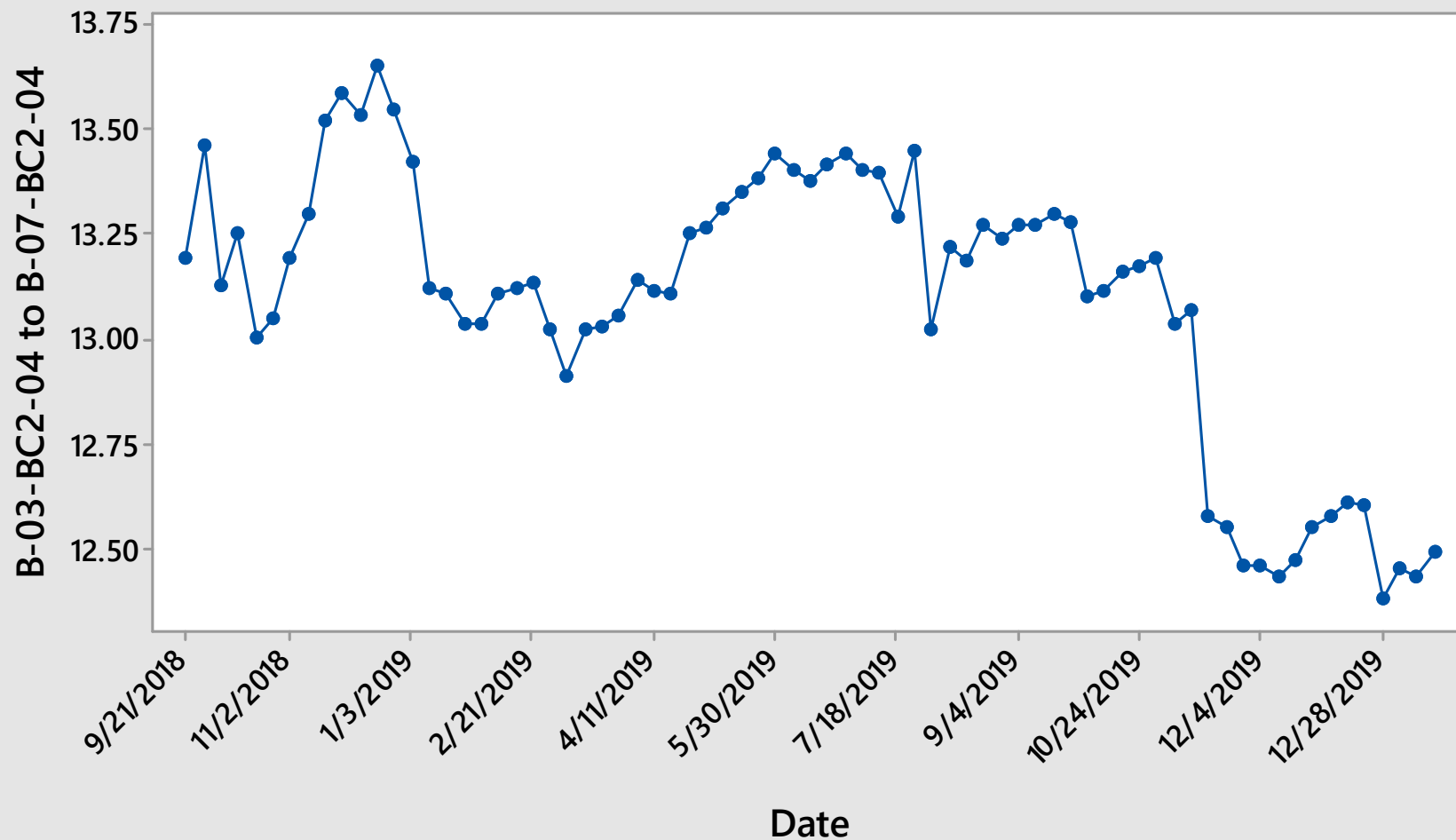




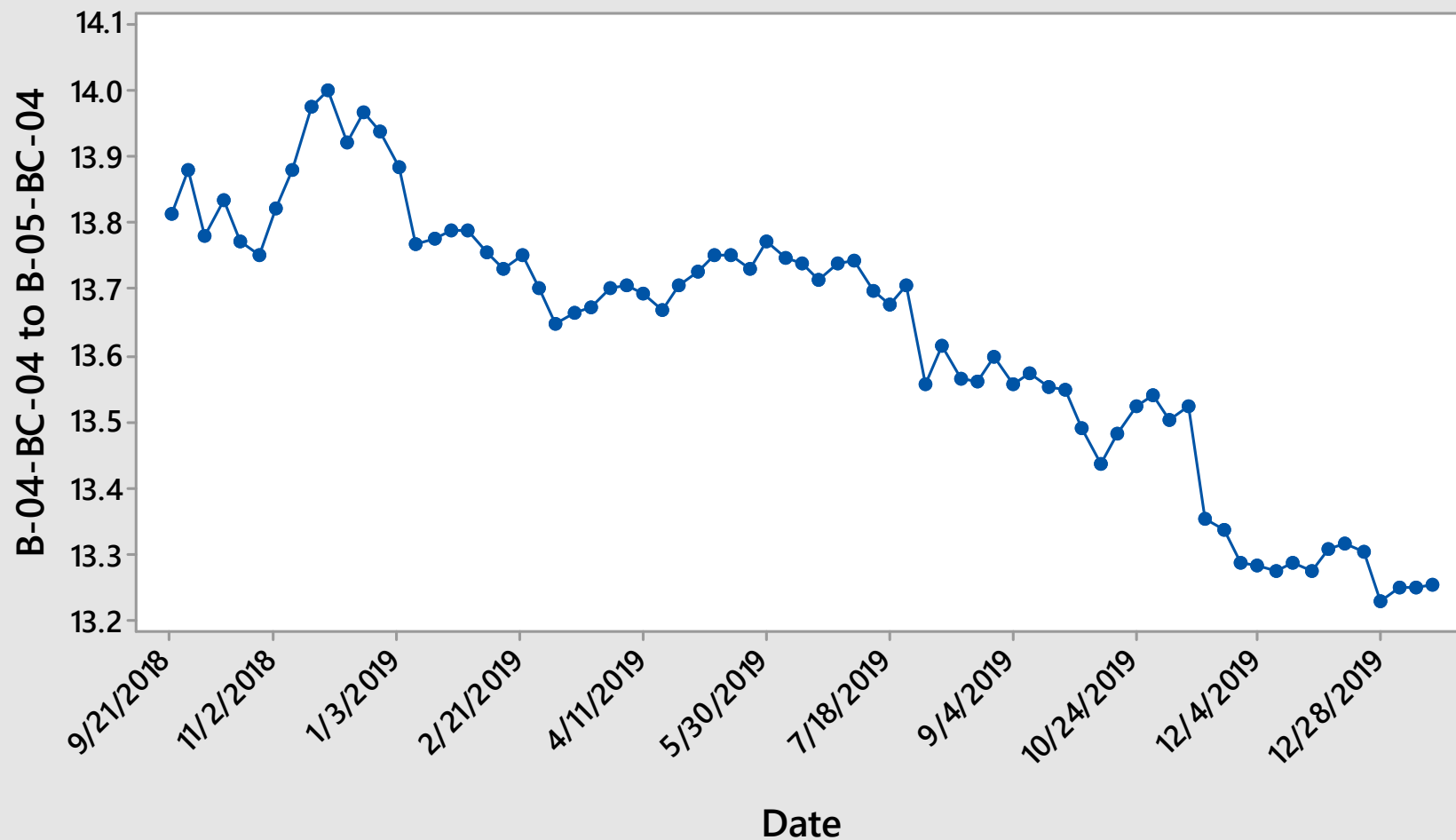
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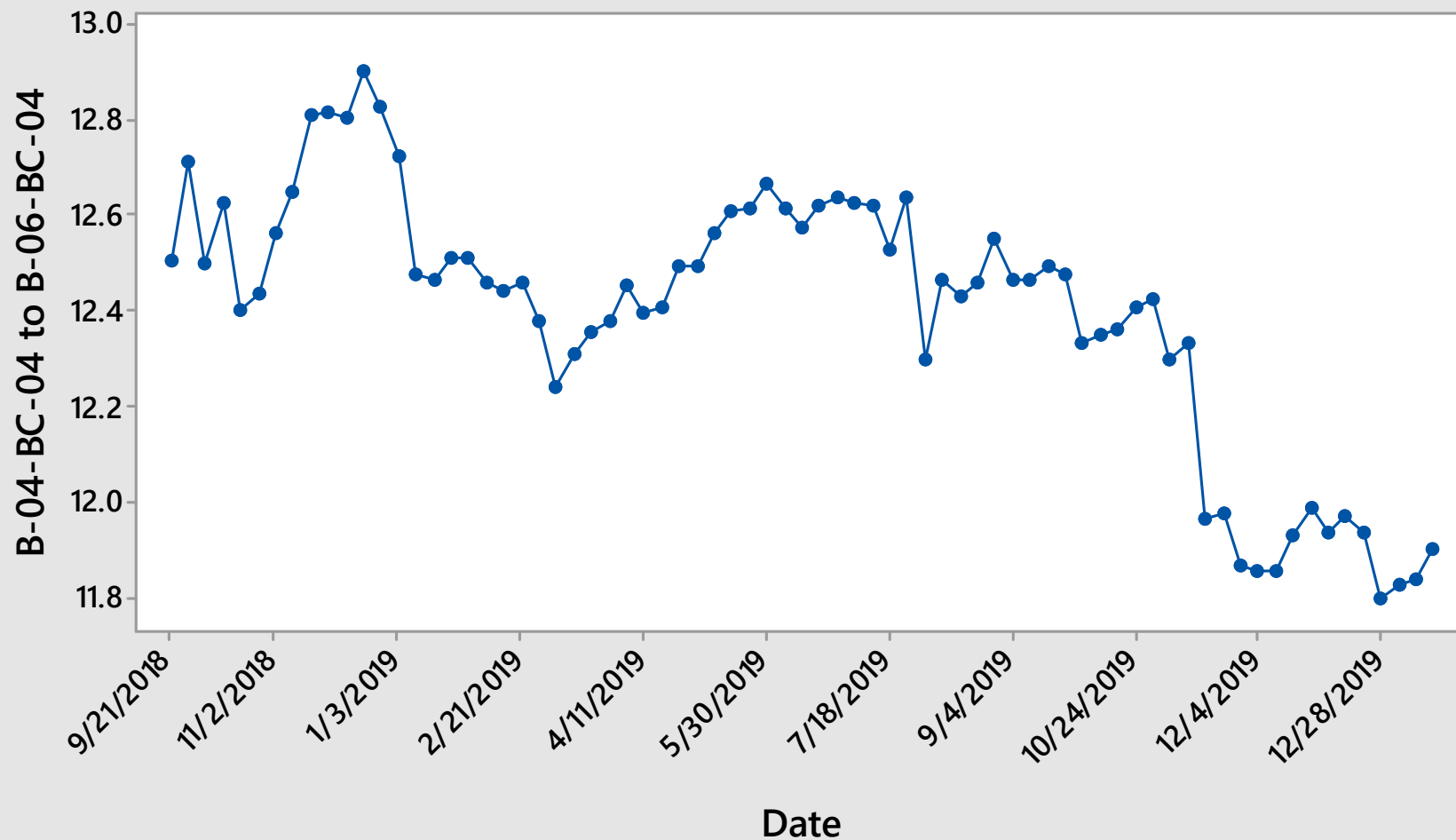
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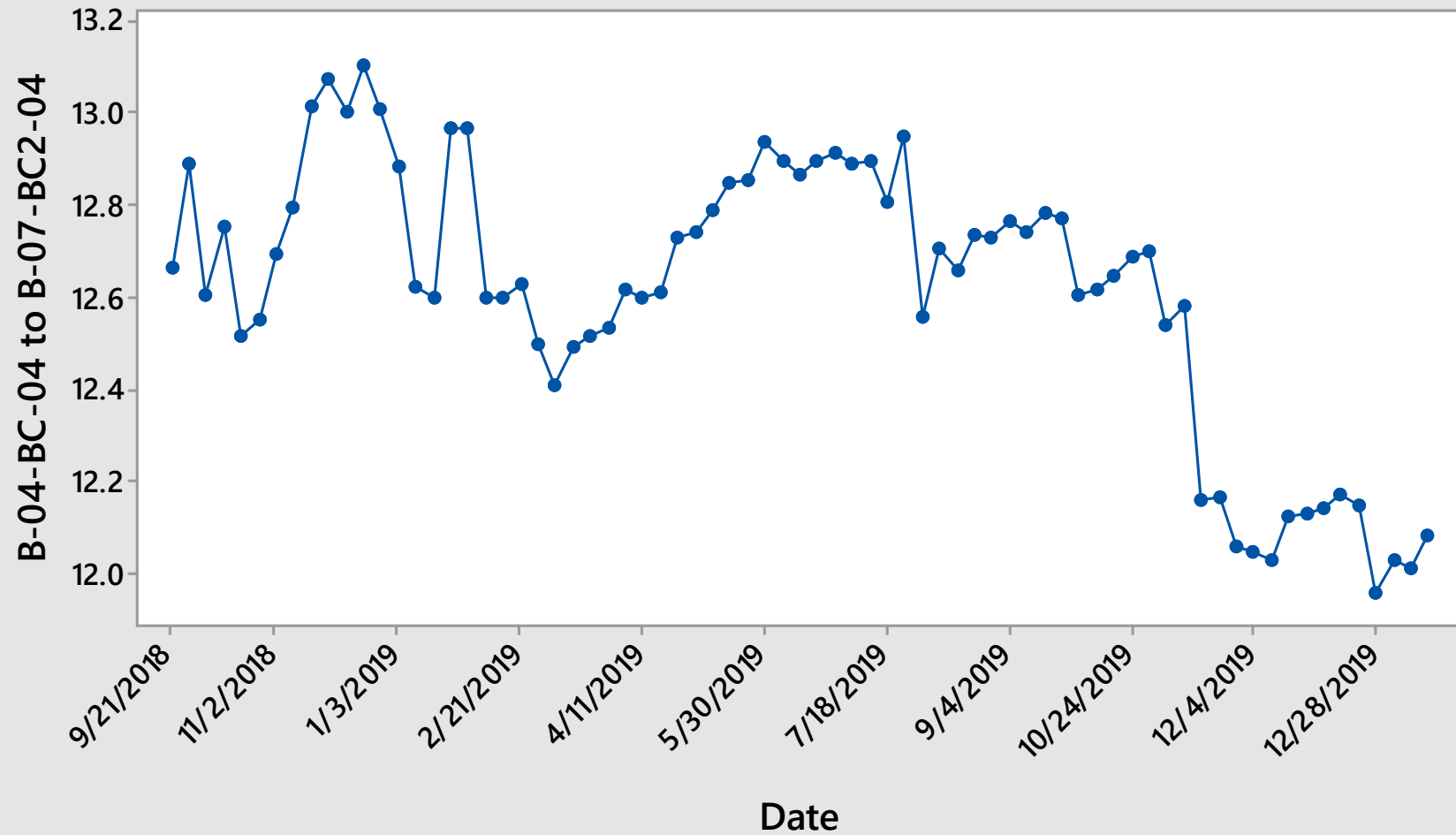
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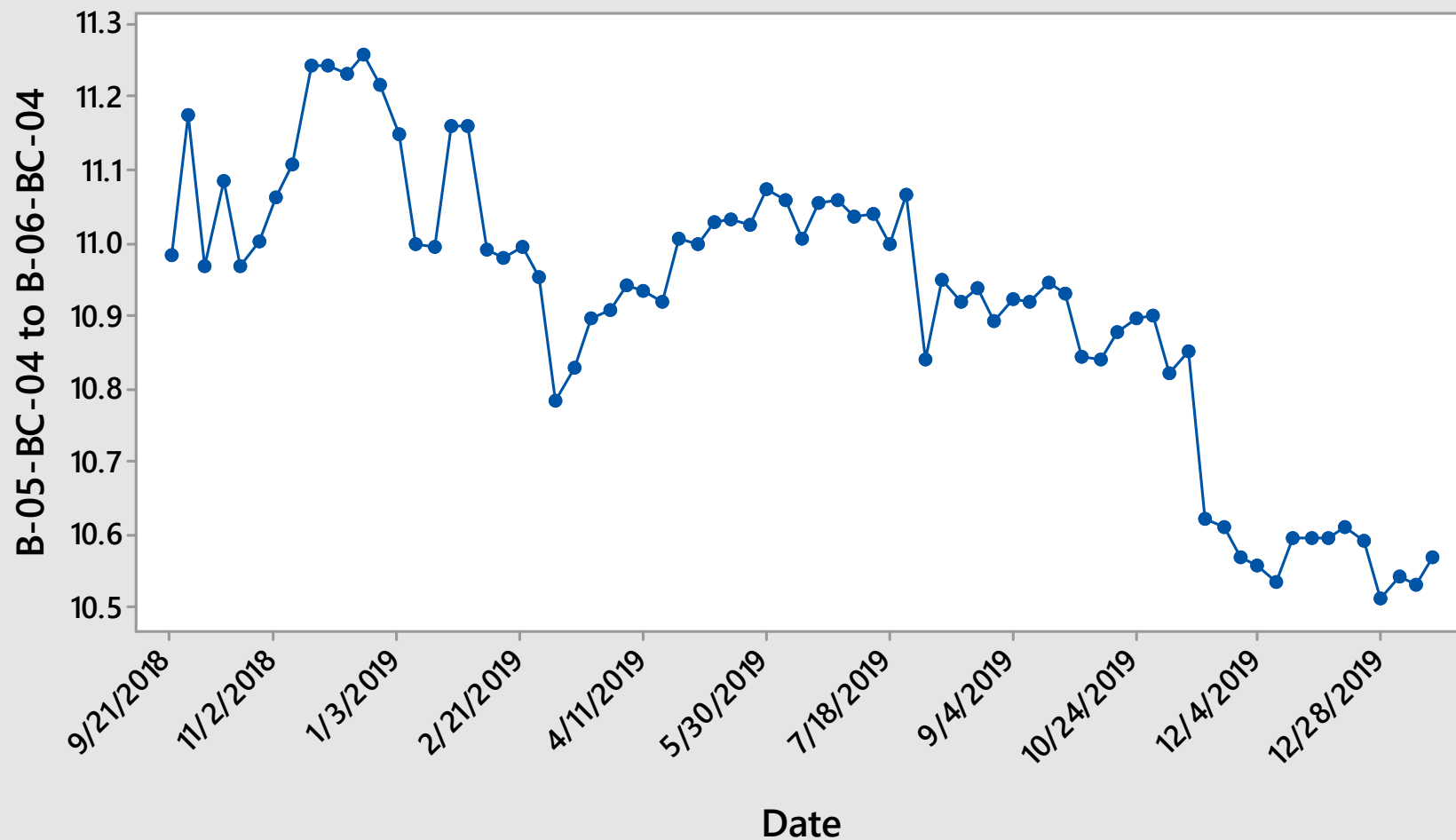
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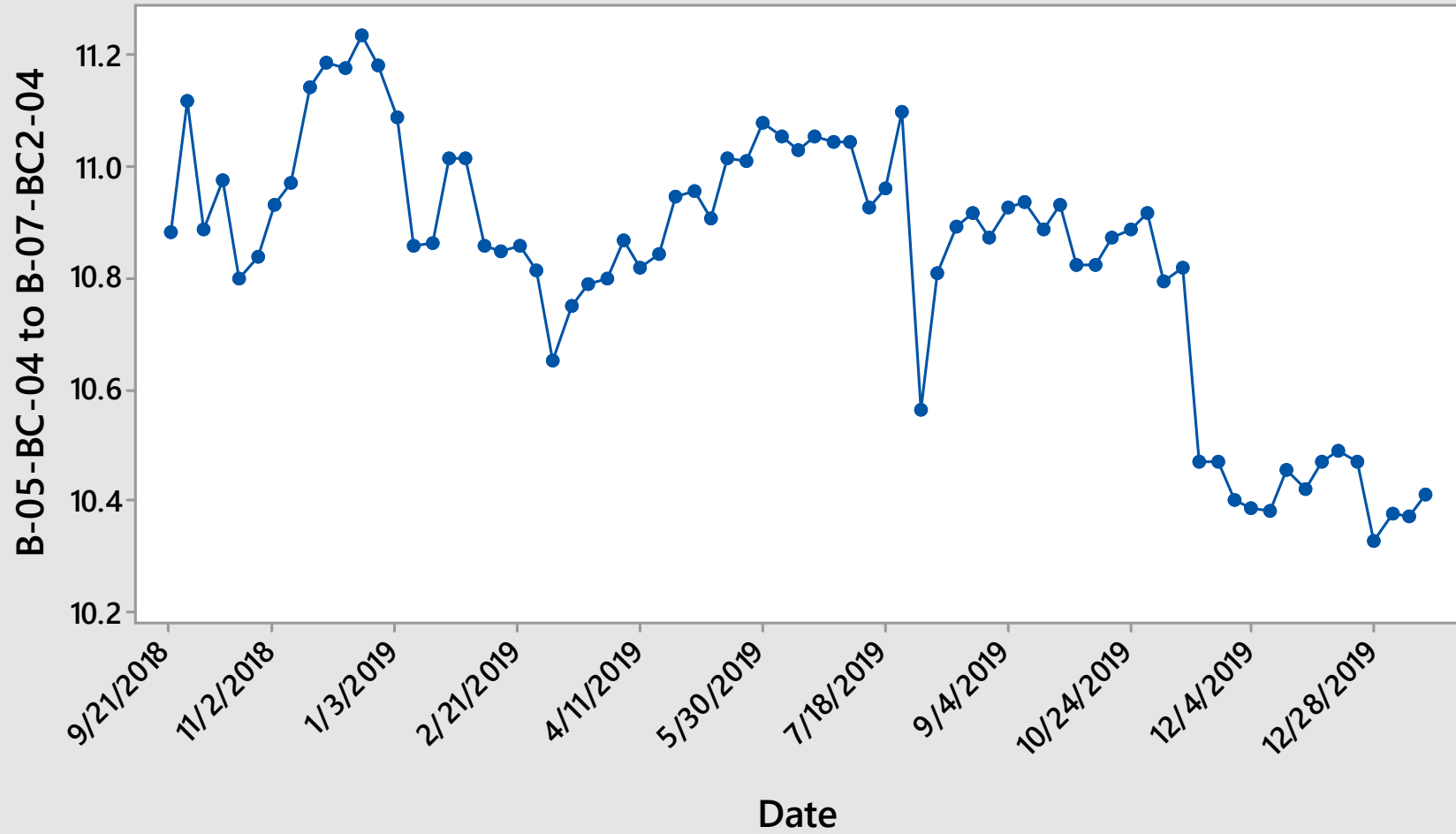


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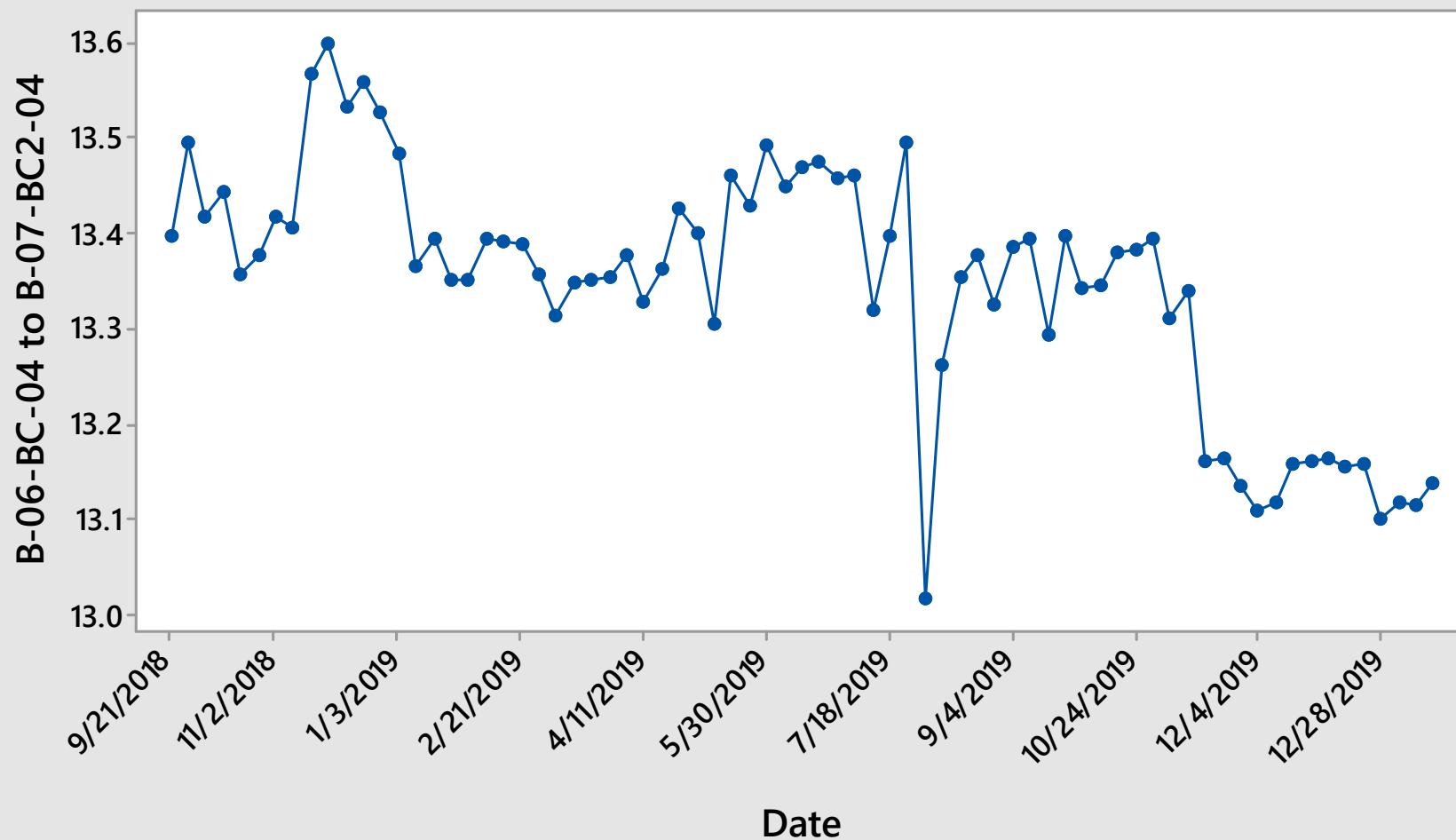




Time Series Plot of B-05-BC-04 to B-07-BC2-04  
HORIZON-4



Time Series Plot of B-06-BC-04 to B-07-BC2-04  
HORIZON-4





**STATE OF ARIZONA**  
**TEMPORARY AQUIFER PROTECTION PERMIT NO. P- 106360**  
**PLACE ID 1579, LTF 80030**  
**OTHER AMENDMENT**

**1.0 AUTHORIZATION**

In compliance with the provisions of Arizona Revised Statutes (A.R.S.) Title 49, Chapter 2, Articles 1, 2 and 3, Arizona Administrative Code (A.A.C.) Title 18, Chapter 9, Articles 1 and 2, A. A. C. Title 18, Chapter 11, Article 4 and amendments thereto, and the conditions set forth in this permit, the Arizona Department of Environmental Quality (ADEQ) hereby authorizes Florence Copper Inc. to operate the Florence Copper Project- Pilot Test Facility Florence, Pinal County, Arizona, over groundwater of the Pinal Active Management Area, in Section 28, Range 9E, Township 4S Gila and Salt River Base Line and Meridian.

This permit becomes effective on the date of the Water Quality Division Director's signature and shall be valid until December 14, 2020, unless suspended or revoked pursuant to A.A.C. R18-9-A213. The permittee shall construct, operate and maintain the permitted facilities

1. Following all the conditions of this permit including the design and operational information documented or referenced below, and
2. Such that Aquifer Water Quality Standards (AWQS) are not violated at the applicable point of compliance (POC) set forth below, or if an AWQS for a pollutant has been exceeded in an aquifer at the time of permit issuance, that no additional degradation of the aquifer relative to that pollutant, and as determined at the applicable POC, occurs as a result of the discharge from the facility.

**1.1 PERMITTEE INFORMATION**

**Facility Name:** Florence Copper Project Production Test Facility  
**Facility Address:** Florence Copper Inc.  
1575 W. Hunt Highway  
Florence, AZ 85132

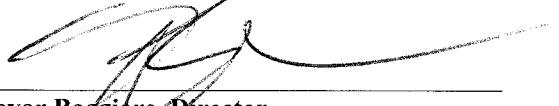
**Annual Registration Fee Flow Rate:** 432,000 gallons per day (gpd)

**Permittee:** Florence Copper Inc.  
**Permittee Address:** 1575 W. Hunt Highway  
Florence, AZ 85132

**Facility Contact:** Richard Tremblay, Vice President Operations  
**Emergency Phone No.:** (520) 374-3984

**Latitude/Longitude:** 33° 03' 1.4" N / 111° 26' 4.7" W  
**Legal Description:** Township 4S, Range 9E, Section 28 Gila and Salt River Base Line and Meridian

**1.2 AUTHORIZING SIGNATURE**

  
\_\_\_\_\_  
**Trevor Baggione, Director**  
**Water Quality Division**  
**Arizona Department of Environmental Quality**  
Signed this 13th day of February, 2020

**THIS AMENDMENT SUPERSEDES ALL PREVIOUS PERMITS**

## 2.0 SPECIFIC CONDITIONS [A.R.S. §§ 49-203(4), 49-241(A)]

### 2.1 Facility / Site Description [A.R.S. § 49-243(K)(8)]

The Temporary Individual Aquifer Protection Permit (APP) is for a Production Test Facility (PTF), a pilot scale test facility located on approximately 160 acres of the Arizona State Land (Mineral Lease 11-26500). The Temporary APP is to construct and operate a production test facility which shall provide sufficient data to assess and develop a full-scale in-situ mining operation.

The PTF will occupy approximately 13.8 contiguous acres and the PTF well field will occupy approximately 2.2 acres. Florence Copper Inc. proposes to construct and operate the PTF over a two-year period, estimated to include an approximate 14 month leaching phase and a 9 month mine block rinsing phase. The PTF well field will contain a total of 24 wells and consists of 4 Underground Injection Control (UIC) Class III injection wells, 9 recovery wells, 7 observation wells, and 4 multilevel sampling wells. The proposed In-Situ Copper Recovery (ISCR) process involves injecting a lixiviant (99.5% water mixed with 0.5% sulfuric acid) through injection wells into the oxide zone of the bedrock beneath the site for the purposes of dissolving copper minerals from the ore body. The estimated injection zone is between approximately 500 feet below ground surface (ft bgs) to 1,185 ft bgs. The resulting copper-bearing solution will be pumped by recovery wells to the surface where copper will be removed from the solution in a solvent extraction electro winning (SX/EW) plant. The barren solution from the SX/EW plant will be re-acidified and re-injected back into the oxide zone. Other facilities proposed for the PTF will include the SX/EW Plant, Process Water Impoundment (PWI), Runoff Pond, tank farm and other ancillary facilities.

The site includes the following permitted discharging facilities:

<b>Table 2.1 Permitted Facilities</b>		
<b>Facility</b>	<b>Latitude</b>	<b>Longitude</b>
In-Situ Area Injection and Recovery Well Block	33° 3' 1.39" N	111° 26' 4.69" W
Process Water Impoundment	33° 3' 8.67" N	111° 25' 22.18" W
Run-off Pond	33° 3' 4.66" N	111° 25' 22.6" W

### Annual Registration Fee [A.R.S. § 49-242 and A.A.C. R18-14-104]

The annual registration fee for this permit is established by A.R.S. § 49-242 and is payable to ADEQ each year. The annual registration fee flow rate is established in permit Section 1.1. If the facility is not yet constructed or is incapable of discharge at this time, the permittee may be eligible for reduced fees under the rule. Send all correspondence requesting reduced fees to the Water Quality Division of ADEQ. Please reference the permit number, LTF number and why reduced fees are requested under the rule.

### Financial Capability [A.R.S. § 49-243(N) and A.A.C. R18-9-A203]

The permittee has demonstrated financial capability under A.R.S. § 49-243(N) and A.A.C. R18-9-A203. The permittee shall maintain financial capability throughout the life of this permit. The estimated closure cost is \$5,113,000. The financial assurance mechanism was demonstrated through a performance surety bond payable to ADEQ from Lexon Insurance Company in the amount of \$656,000 (A.A.C. R18-9-A203 (C)(2)), and through a performance surety bond payable to the U.S. Environmental Protection Agency (EPA) Underground Injection Control (UIC) program from Lexon Insurance Company in the amount of \$4,457,000 (A.A.C. R18-9-A203(G)).

### 2.2 Best Available Demonstrated Control Technology [A.R.S. § 49-243(B) and A.A.C. R18-9-A202(A)(5)]

This permit authorizes the temporary operation of the discharging facilities listed below, pursuant to A.A.C. R18-9-A210(E). The intent of the pilot test is to demonstrate that hydraulic control of the in-situ solution can be maintained at the site in order to conduct a copper recovery process. The discharging facilities and their BADCT descriptions are also presented in Section 4.1, Table 4.1-1.

## **2.2.1 Engineering Design**

### **2.2.1.1 In-Situ Area Injection and Recovery Well Block**

Design, construction, testing (mechanical integrity), and operation of injection and recovery wells shall follow EPA Class III rules (40 CFR Part 146). The maximum fracture pressure shall be no greater than 0.65 pounds per square inch per foot (psi/ft) of depth. Hydraulic control shall be maintained at all times, within the pilot test facility well block, by pumping recovery wells at a rate greater than the injection rate in order to maintain a cone of depression that extends at least 500 feet from the in-situ area injection and recovery well block. The injection and extraction volumes shall be metered at the well-heads, monitored daily, and recorded. Surface water control shall be provided for the PTF injection and recovery well sites.

### **2.2.1.2 Process Water Impoundment**

The Process Water Impoundment (PWI), a process solution pond, shall be used to evaporate neutralized solutions and contain resulting sediments. The PWI shall be located immediately north of the runoff pond which is directly north of the SX/EW plant. The PWI shall have a capacity of approximately 1.7 million cubic feet, approximately 15 to 23-feet deep, with internal and external side slopes of 2.5-feet horizontal to 1.0-feet vertical (2.5H:1V), and maintain a minimum of two (2) feet freeboard. The PWI shall be designed as a double liner system and include a leak collection and removal system (LCRS). The liner system shall consist of, from bottom to top; a compacted sub-grade (foundation) with liner bedding, 60-mil HDPE secondary liner, geonet, and 60-mil primary liner. The LCRS shall be equipped with: a sump located at the lowest elevation of the pond; a sump pump to remove accumulated liquids; and an alarm system for fluid detection.

### **2.2.1.3 Run-off Pond**

The Runoff Pond, a non-stormwater pond, shall be located directly south of the PWI, north of the adjacent SX/EW plant, and northeast of the Pregnant Leachate Solution (PLS) and Raffinate tank secondary containment structure. The Runoff Pond shall be designed to capture direct precipitation; stormwater runoff from the roofs of on-site structures, cathode storage slab and concrete apron on the south side of the SX/EW Building; fire sprinkler water or process solutions that may enter or overflow the SX/EW Building floor sump; and any spills on or wash down from these areas. The Runoff Pond shall have a capacity of approximately 6,583 cubic feet; approximately 5-feet deep; internal and external side slopes shall be no less than 2.0-feet horizontal to 1.0-feet vertical (2.5H:1V); and pond shall maintain a minimum of two (2) feet freeboard. The Runoff Pond shall be designed with a single liner that includes an engineered compacted sub-grade and 60-mil HDPE geomembrane liner. The Runoff Pond shall incorporate a sump equipped with a pump along with fluid-level detection equipment. When fluid is detected above the level set-point the pump will transfer fluid out of the Runoff Pond to the PWI via pipeline.

### **2.2.2 Site-specific Characteristics**

Not applicable to this permit.

### **2.2.3 Pre-operational Requirements**

Completed.

### **2.2.4 Operational Requirements**

A description of required inspections and operational monitoring for BADCT is included in Section 4.1, Tables 4.1-3, and 4.1-8.

The injection wells at the site are classified as Class III Injection wells by the USEPA and are permitted by EPA's UIC Program. The injection and recovery wells shall be designed to meet the mechanical integrity requirements in the UIC regulations, Code of Federal Regulations (CFR) part

144 and 146. All injection wells and recovery wells shall be designed and installed to prevent injection into the top 40 feet (the exclusion zone) of the oxide zone. The injection of the solutions shall be limited to the Oxide ore body only.

The PTF operation relies on hydraulic control of the ISCR solutions to demonstrate BADCT. Hydraulic control shall be confirmed through the use of observation wells, supplemental wells, MW-01, and POC wells. An inward hydraulic gradient shall be measured by water level elevations in recovery and observation wells. Bulk well field electrical conductivity shall be measured at all observation wells. Fluid electrical conductivity shall be measured at observation and injection wells to confirm hydraulic control. Well bore electrical conductivity shall be measured above the middle fine grained unit (MFGU) on all observation wells, supplemental wells, multi-level sampling wells and operational monitoring well MW-01. Groundwater elevations in wells completed in the Oxide shall be measured to confirm the groundwater elevation at the downgradient edge of the PTF well field is lower than the edge of the PTF well field pollutant management area boundary (i.e. BADCT cone of depression). The rates of injection and recovery shall be continuously monitored and controlled so that the total volume of solution recovered is greater than the volume of solution injected, averaged over 24 hour period. Automatic controls and alarms shall be used in the well field to ensure process upsets do not result in the loss of hydraulic control. Hydraulic control over the injected solutions shall be maintained from the time injection begins and until well abandonment is completed by the applicant and approved by the appropriate agencies and groundwater in the mine blocks meets APP closure criteria.

The injection pressure in the Class III injection wells shall be kept below the fracture pressure of the oxide ore body. A fracture gradient of 0.65 pounds per square inch per foot (psi/ft) of depth was established by field test data as being adequate to prevent hydraulic fracturing of the bedrock.

Observation wells located down-gradient of the injection wells may be temporarily converted to use as recovery wells in order to maintain hydraulic control.

### **2.3 Discharge Limitations [A.R.S. §§ 49-201(14), 49-243 and A.A.C. R18-9-A205(B)]**

The permittee shall operate and maintain all permitted facilities listed below to prevent unauthorized discharges pursuant to A.R.S. §§ 49-201(12) resulting from failure or bypassing of BADCT pollutant control technologies including liner failure, uncontrollable leakage, overtopping (e.g., exceeding maximum storage capacity defined as a fluid level exceeding the crest elevation of a permitted impoundment), berm breaches, accidental spills, or other unauthorized discharges.

#### **2.3.1. In-Situ Area Injection and Recovery Well Block**

Hydraulic control over the injected solutions shall be maintained during the operating life of the facility. In-situ solutions shall be injected and contained within the oxide unit.

#### **2.3.2 Process Water Impoundment**

The PWI shall be used to store neutralized solutions and resulting sediments, and direct precipitation.

#### **2.3.3 Run-off Pond**

The Runoff Pond shall be used to capture direct precipitation; stormwater runoff from roofs on-site structures, cathode storage slab, and concrete apron on the south side of the SX/EW building; fire sprinkler water or process solutions that may enter or overflow the SX/EW Building floor sump; any spills or wash down from these areas; and process upset events.

### **2.4 Point(s) of Compliance [A.R.S. § 49-244]**

The Points of Compliance (POC) are listed in Table 2.4 below. Monitoring shall be conducted at each Point of Compliance (POC) as listed in Section 4.1, Table 4.1-6 and 4.1-7.



**Table 2.4 – Groundwater Monitoring Points of Compliance**

POC #	ADWR No.	Total Well Depth (ft. bgs)	Latitude	Longitude	Screened Interval (ft. bgs)	Aquifer Unit
<b>POCs for In-Situ Well Filed</b>						
M14-GL	55-549172	838	33° 03' 4.0"N	111° 26' 15.77"W	778-838	LBFU
M15-GU	55-547813	594	33° 03' 4.04"N	111° 26' 16.40"W	554-594	LBFU
M22-O	55-555831	1,130	33° 03' 4.53"N	111° 26' 15.76"W	932-1,130	Oxide
M23-UBF	55-555824	250	33° 03' 4.51"N	111° 26' 16.50"W	210-250	UBFU
M54-LBF	55-226792	629	33° 03' 7.07"N	111° 26' 9.29"W	310-629	LBFU
M54-O	55-226798	1,199	33° 03' 6.91"N	111° 26' 9.22"W	668-1,199	Oxide
<b>POCs for Impoundments</b>						
M52-UBF	55-226788	274	33° 03' 11.03"N	111° 25' 24.66"W	200-274	UBFU

The Director may amend this permit to designate additional POCs, if information on groundwater gradients or groundwater usage indicates the need.

#### **2.4.1 New Well Design and Installation**

The permittee shall submit design specification for any other wells that may be installed or modified for ADEQ's prior review and approval. The wells shall be designed with appropriate surface seals, annular seals to prevent cross contamination, plugs above the filter pack to prevent cement grout intrusion into the filter pack and screen, and filter pack and screen size selected for the lithology of the screened interval.

All new wells shall be developed after installation and allowed to recover at least one week prior to collection of an initial groundwater sample.

##### **2.4.1.1 Replacement Wells**

In the event that a well other than a POC well should become unusable or inaccessible due to damage, a significant decrease and/or increase in water level, or any other event, the replacement well(s) shall be approved by ADEQ.

#### **2.5 Monitoring Requirements [A.R.S. § 49-243(B) and (K)(1), A.A.C. R18-9-A206(A)]**

All monitoring required in this permit shall continue for the duration of the permit, regardless of the status of the facility. Monitoring shall commence the first full monitoring period following permit effective date or at a frequency specified by the permit. All sampling, preservation and holding times shall be in accordance with currently accepted standards of professional practice. Trip blanks, equipment blanks and duplicate samples shall also be obtained, and Chain-of-Custody procedures shall be followed, in accordance with currently accepted standards of professional practice. Copies of laboratory analyses and Chain-of-Custody forms shall be maintained at the permitted facility. Upon request, these documents shall be made immediately available for review by ADEQ personnel.

##### **2.5.1 Discharge Monitoring**

Discharge monitoring shall be conducted on a one time basis at the PLS Tank, Raffinate Tank, Process Water Impoundment and Runoff Pond in accordance with Section 4.1, Table 4.1-2A, and the Compliance Schedule in Section 3.0, within 120 days of initial PTF start-up in order to allow

for accurate representation of process solutions. Initial discharge monitoring of the underground workings shall be conducted at the location identified in Section 4.1, Table 4.1-2B and in accordance with Section 2.7.4.3 and the Compliance Schedule, Section 3.0. The underground workings shall be depth specific sampled before the PTF operations begin. Continued underground working discharge monitoring shall also occur during the injection phase at least six months into the mining phase, one month after the mining has ceased, one month after the rinsing phase, and into the closure and post closure monitoring period. Discharge Monitoring Sampling Parameters are listed in Section 4.1, Table 4.1-2C. Results of the discharge monitoring shall be submitted to the Groundwater Protection Value Stream within 30 days from receipt of the laboratory analytical results.

## **2.5.2 Facility / Operational Monitoring**

Facility-specific operational monitoring requirements are listed in Section 4.1, Tables 4.1-3 and 4.1-8.

## **2.5.3 Groundwater Monitoring and Sampling Protocols**

Static water levels shall be measured and recorded prior to sampling. Wells shall be purged of at least three borehole volumes (as calculated using the static water level) or until field parameters (pH, temperature, and conductivity) are stable, whichever represents the greater volume. If evacuation results in the well going dry, the well shall be allowed to recover to 80 percent of the original borehole volume, or for 24 hours, whichever is shorter, prior to sampling. If after 24 hours there is not sufficient water for sampling, the well shall be recorded as "dry" for the monitoring event. An explanation for reduced pumping volumes, a record of the volume pumped, and modified sampling procedures shall be reported and submitted with the Self-Monitoring Report Form (SMRF).

As an alternative method for sampling, the permittee may conduct the sampling using the low-flow purging method described in the Arizona Water Resources Center March 1995 Field Manual for Water Quality Sampling. Under this method, the well must be purged until at least two indicator parameters stabilize. Indicator parameters shall include dissolved oxygen, turbidity, pH, temperature and conductivity.

### **2.5.3.1 POC Well Installation**

POC wells M54-LBF, M54-O and M52-UBF were installed in accordance with Section 2.4 and the Compliance Schedule Item 9 in Section 3.0.

### **2.5.3.2 Quarterly Compliance Groundwater Monitoring for POCs**

The permittee shall perform quarterly compliance groundwater monitoring of the POC wells as specified in Section 4.1, Table 4.1-6. The results of the monitoring shall be compared to the AQLs and ALs.

The permittee shall submit reports of the quarterly compliance monitoring in accordance with the reporting schedule at Section 2.7.6.

### **2.5.3.3 Semi-Annual Compliance Monitoring for POCs**

The permittee shall perform semi-annual compliance monitoring of the POC wells as specified in Section 4.1, Table 4.1-7. The results of the monitoring shall be compared to the AQLs and ALs.

The permittee shall submit reports of the semi-annual compliance monitoring in accordance with the reporting schedule at Section 2.7.6.

### **2.5.3.4 Point of Compliance Well Replacement**

In the event that one or more of the designated POC wells should become unusable or

inaccessible due to damage, or any other event, a replacement POC well shall be constructed and installed upon approval by ADEQ. If the replacement well is 50 feet or less from the original well, the ALs and/or AQLs calculated for the designated POC well shall apply to the replacement well.

#### **2.5.4 Surface Water Monitoring and Sampling Protocols**

Not applicable to this permit.

#### **2.5.5 Analytical Methodology**

All samples collected for compliance monitoring and soil sampling shall be analyzed using Arizona state-approved methods. If no state-approved method exists, then any appropriate EPA-approved method shall be used. Regardless of the method used, the detection limits must be sufficient to determine compliance with the regulatory limits of the parameters specified in this permit. If all methods have detection limits higher than the applicable limit, the permittee shall follow the applicable contingency requirements of Section 2.6 and may propose "other actions" including amending the permit to set higher limits. Analyses shall be performed by a laboratory licensed by the Arizona Department of Health Services, Office of Laboratory Licensure and Certification. For results to be considered valid, all analytical work shall meet quality control standards specified in the approved methods. A list of Arizona state-certified laboratories can be obtained at the address below:

Arizona Department of Health Services  
Office of Laboratory Licensure and Certification  
250 North 17<sup>th</sup> Avenue  
Phoenix, AZ 85007  
Phone: (602) 364-0720

#### **2.5.6 Installation and Maintenance of Monitoring Equipment**

Monitoring equipment required by this permit shall be installed and maintained so that representative samples required by the permit can be collected. If new groundwater wells are determined to be necessary, the construction details shall be submitted to the ADEQ Groundwater Protection Value Stream for approval prior to installation and the permit shall be amended to include any new monitoring points.

#### **2.5.7 Protection of Downgradient Uses - Arsenic**

For purposes of this permit, ADEQ has established a use protection level (UPL) for arsenic of 0.01 milligrams per liter (mg/L), consistent with EPA's primary drinking water standard for arsenic. The northwest corner of the State Mineral Lease Land, on which the PTF shall be located, has been conservatively designated as the downgradient point at which the arsenic UPL will be applied. Consistent with ADEQ's substantive policy statement titled "Using Narrative Aquifer Water Quality Standards to Develop Permit Conditions for Aquifer Protection Permits" (Oct. 2003), an alert level for arsenic shall be established for each of the POC wells M14-GL, M15-GU, M22-O, M23-UBF, M54-LBF, and M54-O for the in-situ well field through consideration of fate and transport of arsenic in groundwater to ensure that the UPL is not exceeded at the northwest corner of the State Mineral Lease Land (See Compliance Schedule, Section 3.0).

#### **2.5.8 BADCT Monitoring Wells (Non-POC)**

##### **2.5.8.1 Monitoring well MW-01**

Monitoring requirements for these wells are listed in Section 4.1, Tables 4.1-6b, 4.1-7b and 4.1-8.

##### **2.5.8.2 Supplemental Wells**

Monitoring requirements for these wells are listed in Section 4.1, Tables 4.1-6b, 4.1-7b and 4.1-8.

**Table 2.5-1 – Groundwater Monitoring and Supplemental Groundwater Monitoring Wells**

Well #	ADWR No.	Total Well Depth (ft. bgs)	Latitude	Longitude	Screened Interval (ft. bgs)	Aquifer Unit
MW-01-LBF	55-226789	440	33° 03' 02.9442" N	111° 26' 07.1046" W	330-440	LBFU
MW-01-O	55-226793	1200	33° 03' 03.045" N	111° 26' 06.9786" W	500-1,200	Oxide
<b>SUPPLEMENTAL GROUNDWATER MONITORING WELLS</b>						
M55-UBF	55-226797	261	33° 03' 1.99"N	111° 26' 6.18"W	240-261	UBFU
M56-LBF	55-226795	340	33° 03' 2.21"N	111° 26' 6.44"W	320-340	LBFU
M57-O	55-226790	1200	33° 03' 1.88"N	111° 26' 8.39"W	523-1200	Oxide
M58-O	55-226794	1200	33° 03' 5.20"N	111° 26' 4.94"W	594-1200	Oxide
M59-O	55-226791	1200	33° 03' 1.58"N	111° 26' 2.25"W	534-1200	Oxide
M60-O	55-226796	1201	33° 02' 58.70"N	111° 26' 5.78"W	444-1201	Oxide
M61-LBF	55-226799	630	33° 03' 0.85"N	111° 25' 58.92"W	429-630	LBFU

**2.5.8.3 Observation Wells**

The Observation wells are located in order to provide data for inward hydraulic gradient and electrical conductivity monitoring. These wells are also used in generating potentiometric surface maps. Monitoring requirements for these wells is listed in Section 4.1, Table 4.1-8.

**Table 2.5-2 – Observation Wells**

Well #	ADWR No.	Interval (ft. bgs.)	Latitude	Longitude	Total Well Depth (ft. bgs.)	Aquifer Unit
O-01	55-227230	500-1201	33° 03' 2.09"N	111° 26' 3.71"W	1201	Oxide
O-02	55-227231	500-1201	33° 03' 1.39"N	111° 26' 3.03"W	1201	Oxide
O-03	55-227232	450-1201	33° 02' 59.99"N	111° 26' 3.04"W	1201	Oxide
O-04	55-227233	498-1200	33° 02' 59.29"N	111° 26' 5.54"W	1200	Oxide
O-05B	55-227234	450-1200	33° 02' 59.996"N	111° 26' 6.36"W	1201	Oxide
O-06	55-227235	499-1201	33° 03' 1.396"N	111° 26' 6.35"W	1201	Oxide
O-07	55-227236	446-1198	33° 03' 2.08"N	111° 26' 5.51"W	1198	Oxide

**2.5.8.4 Multi-Level Wells**

The Multi-Level wells are primarily used for obtaining process solution chemistry during the PTF operation between injection and recovery wells. These wells shall be monitored for well bore electrical conductivity as required in Section 4.1, Table 4.1-8.

**Table 2.5-3 – Multi-Level Wells for Well Bore Electrical Conductivity**

Well #	DWR #	Latitude	Longitude
WB-01	55-227226	33° 03' 1.04"N	111° 26' 4.69"W
WB-02	55-227227	33° 03' 0.69"N	111° 26' 4.29"W
WB-03	55-227228	33° 03' 0.35"N	111° 26' 4.70"W
WB-04	55-227229	33° 03' 0.69"N	111° 26' 5.11"W

**2.5.9 Ambient LBFU Bulk Electrical Conductivity**  
Completed.

## **2.6 Contingency Plan Requirements**

**[A.R.S. § 49-243(K)(3), (K)(7) and A.A.C. R18-9-A204 and R18-9-A205]**

### **2.6.1 General Contingency Plan Requirements**

At least one copy of this permit and the approved contingency and emergency response plans submitted in the application shall be maintained at the location where day-to-day decisions regarding the operation of the facility are made. The permittee shall be aware of and follow the contingency and emergency plans.

Any AL that is exceeded or any violation of an AQL, discharge limit (DL), or other permit condition shall be reported to ADEQ following the reporting requirements in Section 2.7.3.

Some contingency actions may involve verification sampling. Verification sampling shall consist of the first follow-up sample collected from a location that previously indicated a violation or the exceedance of an AL. Collection and analysis of the verification sample shall use the same protocols and test methods to analyze for the pollutant or pollutants that exceeded an AL or violated an AQL. The permittee is subject to enforcement action for the failure to comply with any contingency actions in this permit. Where verification sampling is specified in this permit, it is the option of the permittee to perform such sampling. If verification sampling is not conducted within the timeframe allotted, ADEQ and the permittee shall presume the initial sampling result to be confirmed as if verification sampling has been conducted. The permittee is responsible for compliance with contingency plans relating to the exceedance of an AL or violation of a DL, AQL or any other permit condition.

### **2.6.2 Exceeding of Alert Levels**

#### **2.6.2.1 Exceeding of Alert Levels Set for Operational Conditions**

1. If an Operational Condition for BADCT in Section 4.1, Table 4.1-3 has been exceeded, the permittee shall:
  - a. Notify the ADEQ Groundwater Protection Value Stream within five (5) days of becoming aware of a violation of any permit condition in accordance with Section 2.7.3 (Permit Violation and Alert Level Reporting), unless other reporting is specified in Section 4.1, Table 4.1-3.
  - b. Submit a written report within thirty (30) days after becoming aware of a violation of a permit condition in accordance with Section 2.7.3. The report shall document all of the following:
    - i. a description of the exceeded value or performance standard and its cause;
    - ii. the period of violation, including exact date(s) and time(s), if known, and the anticipated time period during which the violation is expected to continue;
    - iii. any action taken or planned to mitigate the effects of the violation, or the spill, or to eliminate or prevent recurrence of the violation;
    - iv. any monitoring activity or other information which indicates that any pollutants would be reasonably expected to cause a violation of an Aquifer Water Quality Standard; and
    - v. any malfunction or failure of pollution control devices or other equipment or process.
2. The facility is no longer on alert status once the operational indicator no longer indicates that an Operational Condition is being exceeded. The permittee shall, however, complete all tasks necessary to return the facility to its pre-alert operating condition.

#### **2.6.2.2 Exceedance of Alert Level #1 for Normal Liner Leakage**

If an Alert Level #1 (AL #1) as specified in Section 4.1, Table 4.1-4, has been exceeded, the permittee shall take the following actions:

1. Within 5 days of discovery, determine if the fluid in the collection sump is operational/process water from the impoundment by measuring the pH and conductivity of fluids in the impoundment and in the sump to allow direct comparison in wastewater quality. Notify ADEQ Groundwater Protection Value Stream in accordance with Section 2.7.3(1) (Permit Violation and AL Status Reporting), and include in the notification an assessment of the type of water in the sump. Monitor fluid removal from the LCRS on a daily basis until the daily volume of fluid quantified remains below AL#1 for 30 days in order to minimize the hydraulic head on the lower liner.
2. Within 15 days of discovery, assess the condition of the liner system using visual methods for visible portions of the liner, electrical leak detection, or other methods as applicable to determine the location of leaks in the primary liner. If liner damage is evident, the permittee shall complete liner repairs and submit documentation of the repairs in the initial report discussed in Item No. 3 below.
3. Within 30 days of discovery of exceeding AL#1, the permittee shall submit an initial report to ADEQ Groundwater Protection Value Stream to address problems identified from the initial assessment of the liner system, the source of the fluid, and any remedial actions taken to minimize the future occurrences. The report shall include the results of the initial liner evaluation, methods used to locate the leak(s) if applicable, any repair procedures implemented to restore the liner to optimal operational status if required, and other information necessary to ensure the future occurrence of the incidence will be minimized. The permittee shall also submit the report required under Section 2.7.3.
4. For leakage rates that continue to exceed AL #1 and are below AL #2, a Liner Leakage Assessment Report shall be included in the next annual report described in Section 2.7.4 (Operational, Other or miscellaneous Reporting) of this permit. The permittee may also submit the Liner Leakage Assessment Report to the ADEQ prior to the annual report due date. This Liner Leakage Assessment Report shall be submitted to the ADEQ Groundwater Protection Value Stream.

ADEQ will review the Liner Leakage Assessment Report and may require that the permittee take additional action to address the problems identified from the assessment of the liner and perform other applicable repair procedures as directed by the ADEQ, including repair of the liner or addressing and controlling infiltration of non-operational water detected in the LCRS.

#### **2.6.2.3 Exceedance of Alert Level #2 (Discharge Limit) for Liner Failure or Rips**

If the Liner Leakage Discharge Limit (AL #2) specified in Section 4.1, Table 4.1-4, has been exceeded, the permittee shall:

1. Immediately cease all discharge to the impoundment, and notify ADEQ's Groundwater Protection Value Stream orally, electronically, or, by facsimile, of the AL #2 exceedance. Within 24 hours, determine if water in the collection sump is operational/process water from the impoundment by measuring the pH and conductivity of fluids contained in the impoundment and in the sump to allow direct comparison in water quality.
2. Within 5 days of discovery, notify ADEQ Groundwater Protection Value Stream, in accordance with Section 2.7.3 (Permit Violation and AL Status Reporting) and include an assessment regarding the type of water in the sump based upon the measurements taken according to Item No. 1 listed above.
3. Within 15 days of discovery identify the location of the leak(s) using visual methods, electrical leak detection, or other methods as applicable. If liner damage is evident, the permittee shall complete liner repairs and submit documentation of the repairs in Item No. 4 below. Discharge to the impoundment shall not be re-initiated until



the leak(s) have been identified and repaired.

4. Within 30 days of exceeding AL #2, submit a report to ADEQ as specified in Section 2.7.3 (Permit Violation and AL Status Reporting). The report shall include the results of the initial liner evaluation, methods used to locate the leak(s) if applicable, any repair procedures and quality assurance/quality control implemented to restore the liner to optimal operational status if required, and other information necessary to ensure the future occurrence of the incidence will be minimized. Upon review of the report, ADEQ may request additional monitoring or remedial actions.
5. If AL #2 continues to be exceeded following completion of repairs, submit for approval to ADEQ, a corrective action plan including a schedule to complete the corrective actions to address all problems identified from the assessment of the liner system and surface releases, if any, within 60 days of completion of repairs conducted in response to Item No. 3 above. Upon ADEQ's approval, the permittee shall implement the approved plan and schedule of corrective actions.
6. Within 30 days of completion of corrective actions, submit to ADEQ, a written report as specified in Section 2.6.6 (Corrective Actions).

#### **2.6.2.4 Exceeding of Alert Levels in Groundwater Monitoring**

##### **2.6.2.4.1 Alert Levels for Indicator Parameters**

1. If an AL in Section 4.1 Table 4.1-6, 4.1-6B, 4.1-7 or Table 4.1-7B been exceeded, the permittee shall request that the laboratory verify the sample results within 5 days. If the analysis does not confirm that an exceedance has occurred, no further action is required.
2. Within 5 days after receiving laboratory confirmation of an AL being exceeded, the permittee shall notify the ADEQ Groundwater Protection Value Stream and submit written confirmation within 30 days of receiving the laboratory confirmation of an AL exceedance.
3. If the results indicate an exceedance of an AL, the permittee shall conduct a verification sample of groundwater from the well within 15 days from laboratory confirmation. If the verification sample does not confirm that an exceedance has occurred, the permittee shall notify ADEQ Groundwater Protection Value Stream of the results. No further action is required under this subsection.
4. If verification sampling confirms that the AL has been exceeded, the permittee shall increase the frequency of monitoring to monthly and analyze for the entire list of parameters listed in Section 4.1, Table 4.1-6 or Table 4.1-6B, and increase the monitoring frequency to quarterly for parameters listed in Tables 4.1-7 or 4.1-7B. In addition, the permittee shall immediately investigate the cause of the exceedance and report the results of the investigation with the 30 day confirmation noted above. ADEQ may require additional investigations, the installation of additional wells or corrective action in response to the report. The permittee shall continue monthly testing for the parameter(s) until the parameter(s) has remained below the AL for three consecutive monthly sampling events.

##### **2.6.2.4.2 Alert Levels for Pollutants with Numeric Aquifer Water Quality Standards**

1. If an AL for a pollutant set in Section 4.1, Table 4.1-6, 4.1-6B, 4.1-7 or Table 4.1-7B has been exceeded, the permittee may conduct verification sampling of the pollutant(s) that exceed their respective AL(s) within 5 days of becoming aware of an AL exceedance. The permittee may use the results of another sample taken between the date of the last sampling event and the date of receiving the result as verification.

2. If verification sampling confirms the AL exceedance or if the permittee opts not to perform verification sampling, then the permittee shall increase the frequency of monitoring to monthly of the pollutant(s) that exceed their respective AL(s). In addition, the permittee shall immediately initiate an investigation of the cause of the AL exceedance, including inspection of all discharging facilities and all related pollution control devices, review of any operational and maintenance practices that might have resulted in an unexpected discharge, and hydrologic review of groundwater conditions including upgradient water quality from existing wells.
3. The permittee shall initiate actions identified in the approved contingency plan referenced in Section 3.0 and specific contingency measures identified in Section 2.6 to resolve any problems identified by the investigation which may have led to an AL exceedance. To implement any other corrective action the permittee shall obtain prior approval from ADEQ according to Section 2.6.6. Alternatively, the permittee may submit a technical demonstration, subject to written approval by the Groundwater Protection Value Stream, that although an AL is exceeded, the pollutant(s) that exceed their respective AL(s) are not reasonably expected to cause a violation of an AQL. The demonstration may propose a revised AL or monitoring frequency for approval in writing by the Groundwater Protection Value Stream.
4. Within 30 days after confirmation of an AL exceedance, for those pollutant(s), the permittee shall submit the laboratory results to the Groundwater Protection Value Stream along with a summary of the findings of the investigation, the cause of the AL exceedance, and actions taken to resolve the problem.
5. Upon review of the submitted report, the Department may amend the permit to require additional monitoring, increased frequency of monitoring, or other actions.
6. The increased monitoring for those pollutant(s) required as a result of an AL exceedance may be reduced to the regularly scheduled frequency, if the results of three (3) sequential sampling events demonstrate that the parameter(s) does not exceed their respective AL(s).
7. If the increased monitoring required as a result of an AL exceedance for those pollutant(s) continues for more than six (6) sequential sampling events, the permittee shall submit a second report documenting an investigation of the continued AL exceedance within 30 days of the receipt of laboratory results of the sixth sampling event.

#### **2.6.2.4.3 Alert Levels to Protect Downgradient Users from Pollutants Using a Narrative Aquifer Water Quality Standard**

1. If an AL set for arsenic in Section 4.1, Table 4.1-6 or 4.1-7 has been exceeded, the permittee shall conduct verification sampling within 5 days of becoming aware of an AL exceedance.
2. If verification sampling confirms that the AL has been exceeded, the permittee shall investigate the cause of the exceedance and shall submit a report regarding the exceedance to ADEQ within 30 days of the date of verification sample. The report shall identify the cause and source(s) of the exceedance and shall propose actions to mitigate the exceedance. The report shall also present groundwater modeling to establish a projected relationship of the wells in which exceedance(s) were found and the downgradient boundary of the Arizona State Land Department property at the facility.

3. The permittee shall notify all downgradient users of the aquifer who may be directly affected by the discharge within 24 hours of receiving the results of verification confirmation sampling.

#### **2.6.2.5 Exceeding of BADCT Alert Levels for Injection/Recovery Well Operation**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1 Table 4.1-8 for the loss of hydraulic control within the in-situ leaching area for more than 24 consecutive hours. A loss of hydraulic control occurs when the amount of fluids injected during a 24 hour period exceeds the amount of fluid recovered for the same 24 hour period. Loss of hydraulic control is also indicated by a less than 1-foot differential observed in any pair of observation and recovery wells over a 24 hour period. The permittee shall:

1. Notify the ADEQ Groundwater Protection Value Stream within one (1) day of becoming aware of the alert level exceedance.
2. Adjust flow rates at injection/recovery wells until the recovery volume is greater than the injected volume,
3. Conduct an inspection, testing of piping, and wellhead for leaks; injection and recovery lines, pumps, flow meters, totalizers, pressure gauges, pressure transducers, and other associated facilities,
4. Review of recent process logs, continuous chart recordings, meter readings, and other operational control information to identify any unusual occurrences,
5. Initiate pressure testing of the appropriate wells if the loss of fluids cannot be determined to be caused by a surface facility failure, and
6. Repair system as necessary.
7. Within one week submit a report to ADEQ Groundwater Protection Value Stream. The report shall include but not be limited to providing the following information: a) injected volume in the period prior to the alert level exceedance, b) recovered volume in the period prior to the alert level exceedance, c) corrective action taken.
8. The permittee is no longer considered to be in violation if the injection rate and recovery rates are re-established and maintained at normal operating conditions following the completion of the corrective actions.

If the exceedance of the Alert Level is determined to be a result of a planned disruption or power outage, the cause will be noted in the log book as required by Section 2.7.2.

If a leak is detected, operation of the well shall cease until the leak has been repaired and mechanical integrity demonstrated to minimize the potential for groundwater pollution.

Within 30 days of the initial AL exceedance caused by a leak, the permittee shall submit a report to ADEQ Groundwater Protection Value Stream at the address shown in Section 2.7.5. This report shall document all submittals to EPA, including but not limited to, monitoring and report data and reports checking engineering and integrity of the well.

The facility is no longer on alert status once the operational indicator no longer indicates that an AL is being exceeded. The permittee shall, however, complete all tasks necessary to return the facility to its pre-alert operating condition.

#### **2.6.2.6 Exceeding of Alert Levels Set for Maximum Injection Pressure**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1, Table 4.1-8 for the exceedance of a fracture gradient. The permittee shall:

1. Immediately investigate to determine the cause of the AL being exceeded, including:

- a. Inspection, testing, and assessment of the current condition of all components of the injection system that may have contributed to the AL being exceeded, which may include taking the affected well(s) out of service, and
  - b. Review of all data logger information, test results, and other operational control information to identify any unusual occurrences.
  - c. Repair system as necessary.
2. Within 30 days of an AL being exceeded, the permittee shall submit the related data to the ADEQ Groundwater Protection Value Stream, along with a summary of the findings of the investigation, the cause of the AL being exceeded, and actions taken to resolve the problem. This report shall document all submittals to EPA, including but not limited to, monitoring and report data and reports checking engineering and integrity of the well.
3. Upon review of the submitted report, the Department may amend the permit to require additional monitoring, increased frequency of monitoring, amendments to permit conditions or other actions.
4. The facility is no longer on alert status once the operational indicator no longer indicates that an AL is being exceeded. The permittee shall, however, complete all tasks necessary to return the facility to its pre-alert operating condition.

#### **2.6.2.7 Exceeding Alert Levels for LBFU Bulk Electrical Conductivity Monitoring**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1, Table 4.1-8 for the exceedance of LBFU Bulk Electrical Conductivity. The permittee shall:

1. Within 14 days of the Alert Level exceedance, the permittee shall collect three additional independent conductivity measurements conducted over a period of six days.
2. Within 5 days of receiving the verification results, if the verified conductivity values remain above Alert Levels, the permittee shall notify ADEQ that further contingency action is being conducted.
3. If the verification measurements indicate an Alert Level exceedance has not occurred, the permittee shall notify ADEQ of the results. No further action is required until the next monitoring round.
4. Within 30 days of receiving conductivity measurement results indicating an Alert Level exceedance has occurred, the permittee shall submit a written report to ADEQ providing an evaluation of the cause, impacts, or mitigation of the discharge responsible for the increase in conductivity, or submit a written report which demonstrates that the increase resulted from errors in conductivity measurement, data analysis, or statistical evaluation.
5. If an Alert Level exceedance is verified, the permittee shall:
  - a. Reduce the injection rate and increase the extraction rate in the area of the increased conductivity values for period of time equal to the period spanning from the previous measurement wherein conductivity values were within the range of background values until the time when the Alert Level exceedance was verified.
  - b. Increase conductivity monitoring frequency from weekly to three times per week.
  - c. If conductivity values remain at levels that exceed Alert Levels, and do not show any decrease after a period of 60 days of reduced injection and increased pumping, the sampling frequency for level 1 parameters at operational monitoring well MW-01 shall be increased to weekly, and level 2 monitoring parameters shall be increased to quarterly.
  - d. If conductivity values remain at levels that exceed Alert Levels, and does not return to below the AL after a period of 60 days of reduced injection

and increased pumping, the permittee shall cease injecting solutions and continue extraction until Bulk Electrical Conductivity concentrations do not exceed the Alert Level.

#### **2.6.2.8 Exceeding Alert Levels for Well Bore Electrical Conductivity**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1, Table 4.1-8 for the exceedance of Well Bore Electrical Conductivity. The permittee shall:

1. Verify the reading from the annular conductivity device, to confirm there was an AL exceedance. If verification does not confirm an AL exceedance, the permittee can resume normal operations and notify the Groundwater Protection Value Stream in accordance with Section 2.7.3.
2. If verification confirms an AL exceedance, the permittee shall notify the ADEQ Groundwater Protection Value Stream within one (1) day of becoming aware of the alert level exceedance.
3. Increase Well Bore Electrical Conductivity monitoring required in Table 4.1-8 to monthly,
4. Increase LBFU Bulk Electrical Conductivity monitoring required in Table 4.1-8 to three times per week,
5. Repair system as necessary.
6. Within 30 days of repairing the system, the permittee shall submit a written report to the Groundwater Protection Value Stream documenting the repair of the system and providing an evaluation of the cause, impacts, or mitigation any impacts to the LBFU, MFGU and/or UBFU.

#### **2.6.2.9 Exceeding Alert Levels for Fluid Electrical Conductivity**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1, Table 4.1-8 for the exceedance of fluid sample electrical conductivity. The permittee shall:

1. Immediately verify the fluid sample electrical conductivity. If the verification sample does not confirm that an exceedance has occurred, the permittee shall notify the ADEQ Groundwater Protection Value Stream of the results. No further action is required.
2. Within 24-hours of confirmation of an AL being exceeded, the permittee shall notify the ADEQ Groundwater Protection Value Stream and immediately investigate the cause of the exceedance.
3. The permittee shall report the results of the investigation within 30 days of confirmation. ADEQ may require reduction of injection rates and increase of pumping rates, additional investigations, the installation of additional wells or corrective action in response to the report

#### **2.6.2.10 Exceeding an Alert Level for Cone of Depression**

The permittee shall initiate the following actions within 24 hours of becoming aware of an Alert Level exceedance listed in Section 4.1, Table 4.1-8 for the cone of depression. The permittee shall:

1. Within 48 hour of becoming aware of the Alert Level exceedance, verify whether an exceedance has occurred by completing the following:
  - a. Evaluate whether the data collection protocols have been properly followed.
  - b. Review field notes for indications of unusual circumstances that may have occurred during the collection of the data.
  - c. Review daily injection and pumping values at the PTF well field at the time of the measurements to confirm that extraction was greater than injection during that period in accordance with Section 2.7.4.4(2), Table 4.1-1 and Table 4.1-8.

- d. Evaluate the pumping conditions at other nearby wells during the time of measurements (i.e. were POC, supplemental, MW-1 wells being purged).
- e. Inspect the equipment used to collect the field measurements.
- f. Determine if the measurement equipment was different from past collection periods, and evaluate the potential effects of differences between the equipment used.
- g. Check the calibration of the equipment used (water sounder, pressure transducers, etc.).
2. If an exceedance is not verified, the permittee shall notify the ADEQ Groundwater Protection Value Stream of the results of the verification. No further action is required.
3. If an exceedance is verified, the permittee shall:
  - a. Reduce the injection rate and increase the pumping rate at the recovery wells to a rate that will cause the cone of depression to no longer exceed the alert level, and notify ADEQ Groundwater Protection Value Stream within 24 hours.
  - b. Increase the frequency of potentiometric surface map compilation to weekly until water level measurements confirm that the cone of depression alert level is no longer exceeded.
  - c. If the cone of depression does not meet the alert level after a period of 30 days of reduced injection and increased pumping, the permittee shall immediately cease injecting solutions, continue extracting until the cone of depression no longer exceeds the alert level, increase the frequency of Level 1 monitoring to monthly and increase the frequency of monitoring the level 2 parameters to quarterly at all Oxide Supplemental Wells (M57-O, M58-O, M59-O and M60-O) and MW-01. Upon taking these actions, the permittee shall notify ADEQ Groundwater Protection Value Stream within 3 days.
4. Once the alert level is no longer exceeded, the permittee shall prepare a summary report to be submitted to the Groundwater Protection Value Stream within 30 days summarizing the findings and actions taken to extend the cone of depression to the PMA boundary.

## 2.6.3 Discharge Limitations Violations

### 2.6.3.1 Liner Failure, Containment Structure Failure, or Unexpected Loss of Fluid

In the event of overtopping, liner failure, containment structure failure, or unexpected loss of fluid as described in Section 2.3, the permittee shall take the following actions:

1. As soon as practicable, cease all discharges as necessary to prevent any further releases to the environment.
2. Within 24 hours of discovery, notify ADEQ Groundwater Protection Value Stream, orally, electronically, or by facsimile.
3. Within 24 hours of discovery of a failure that resulted in a release to the subsurface, collect representative samples of the fluid remaining in affected impoundments and drainage structures, analyze sample(s) according to Section 4.1, Table 4.1-2C and report in accordance with Section 2.7.3 (Permit Violation and AL Status Reporting). In the 30-day report required under Section 2.7.3, include a copy of the analytical results and forward the report to ADEQ Groundwater Protection Value Stream.
4. Within 15 days of discovery, initiate an evaluation to determine the cause for the incident. Identify the circumstances that resulted in the failure and assess the condition of the discharging facility and liner system. Implement corrective actions as necessary to resolve the problems identified in the evaluation. Initiate repairs to any failed liner, system, structure, or other component as needed to restore proper functioning of the discharging facility. The permittee shall not resume discharging to the discharging facility until repairs of any failed liner or structure are performed. Repair procedures, methods, and materials used to restore the system(s) to proper operating condition shall be described in the facility log/recordkeeping file and available for ADEQ



review.

5. Record in the facility log/recordkeeping file the amount of fluid removed, a description of the removal method, and other disposal arrangements. The facility log/recordkeeping file shall be maintained according to Section 2.7.2 (Operation Inspection / Log/Recordkeeping File).
6. Within 30 days of discovery of the incident, submit a report to ADEQ as specified in Section 2.7.3. Include a description of the actions performed in Subsections 1 through 5 listed above. Upon review of the report, ADEQ may request additional monitoring or remedial actions.
7. Within 60 days of discovery, conduct an assessment of the impacts to the subsoil and/or groundwater resulting from the incident. This assessment may include the installation of POC(s) to determine down-gradient groundwater impact from the incident along with commencement of groundwater monitoring per Section 4.1, Table 4.1-7. If soil or groundwater is impacted such that it could or did cause or contribute to an exceedance of an AQL at the applicable point of compliance, submit to ADEQ, for approval, a corrective action plan to address such impacts, including identification of remedial actions and a schedule for completion of activities. At the approval of ADEQ, the permittee shall implement the approved plan.
8. Within 30 days of completion of corrective actions, submit to ADEQ, a written report as specified in Section 2.6.6 (Corrective Actions).
9. Upon review of the report, ADEQ may amend the permit to require additional monitoring, increased frequency of monitoring, amendments to permit conditions, or other actions.

#### **2.6.3.2 Overtopping of a Surface Impoundment**

If overtopping of fluid from a permitted surface impoundment occurs, and results in a discharge pursuant to A.R.S. § 49-201(12), the permittee shall:

1. As soon as practicable, cease all discharges to the surface impoundment to prevent any further releases to the environment.
2. Within 24 hours of discovery, notify ADEQ Groundwater Protection Value Stream.
3. Within 24 hours, collect representative samples of the fluid contained in the surface impoundment. Samples shall be analyzed for the parameters specified in Section 4.1, Table 4.1-2C. Within 30 days of the incident, submit a copy of the analytical results to ADEQ Groundwater Protection Value Stream.
4. As soon as practicable, remove and properly dispose of excess water in the impoundment until the water level is restored at or below the appropriate freeboard as described in Section 4.1, Table 4.1-3. Record in the facility log, the amount of fluid removed, a description of the removal method, and the disposal arrangements. The facility log/recordkeeping file shall be maintained according to Section 2.7.2 (Operation Inspection/LogBook/Recordkeeping File).
5. Within 30 days of discovery, evaluate the cause of the overtopping and identify the circumstances that resulted in the incident. Implement corrective actions and adjust operational conditions as necessary to resolve the problems identified in the evaluation. Repair any systems as necessary to prevent future occurrences of overtopping.
6. Within 30 days of discovery of overtopping, submit a report to ADEQ as specified in Section 2.7.3.2 (Permit Violation and Alert Level Status Reporting). Include a description of the actions performed in Subsections 1 through 5 listed above. Upon review of the report, ADEQ may request additional monitoring or remedial actions.
7. Within 60 days of discovery, and based on sampling in Subsection 3 above, conduct an assessment of the impacts to the subsoil and/or groundwater resulting from the incident.
8. If soil or groundwater is impacted such that it could cause or contribute to an exceedance of an AQL at the applicable point of compliance, submit to ADEQ for

approval, a corrective action plan to address such impacts, including identification of remedial actions and/or monitoring, and a schedule for completion of activities. At the direction of ADEQ, the permittee shall implement the approved plan.

9. Within 30 days of completion of corrective actions, submit to ADEQ, a written report as specified in Section 2.6.6 (Corrective Actions). Upon review of the report, ADEQ may amend the permit to require additional monitoring, increased frequency of monitoring, amendments to permit conditions, or other actions.

#### **2.6.3.3 Inflows of Unexpected Materials to a Surface Impoundment**

The types of materials that are expected to be placed in the permitted surface impoundments are specified in Section 2.3 (Discharge Limitations). If any unexpected materials flow to a permitted surface impoundment, the permittee shall:

1. As soon as practicable, cease all unexpected inflows to the surface impoundment(s).
2. Within 24-hours of discovery, notify ADEQ Groundwater Protection Value Stream.
3. Within five (5) days of the incident, identify the source of the material and determine the cause for the inflow. Characterize the unexpected material and contents of the affected impoundment, and evaluate the volume and concentration of the material to determine if it is compatible with the surface impoundment liner. Based on the evaluation of the incident, repair any systems or equipment and/or adjust operations, as necessary to prevent future occurrences of inflows of unexpected materials.
4. Within 30 days of an inflow of unexpected materials, submit a report to ADEQ as specified in Section 2.7.3.2 (Permit Violation and Alert Level Status Reporting). Include a description of the actions performed in Subsections 1 through 3 listed above.
5. Upon review of the report, ADEQ may amend the permit to require additional monitoring, increased frequency of monitoring, amendments to permit conditions, or other actions including remediation.

#### **2.6.3.4 Unexpected Loss of Fluid in the Injection/Recovery Wells at the PTF**

In the event of an unexpected loss of fluid in the injection/recovery wells, such that fluids are released to the surface, vadose zone, or groundwater, the permittee shall:

1. Within two hours of discovery cease injection in the affected area and/or adjust flow rates at injection/recovery wells until an inward hydraulic gradient is reestablished and excess ISCR solutions are recovered necessary to prevent further releases to the environment,
2. Operate the recovery wells in the affected area until the amount of fluid recovered is in excess of the amount of fluid injected during the 24 hour period,
3. Within 24 hours of discovery, notify ADEQ Groundwater Protection Value Stream.
4. Inspect relevant components such as injection, recovery lines, pumps, flow meters, flow totalizers, pressure gauges, pressure transducers and other associated facilities,
5. Verify proper operations of all facilities within the in-situ leach area,
6. Within 24 hours of discovery, initiate an evaluation to determine the cause for the incident. Identify the circumstances that resulted in the failure and assess the condition of the well. Implement corrective actions as necessary to resolve the problems identified in the evaluation. Initiate repairs to any system, structure, or other component as needed to restore proper functioning of the well. The permittee shall not resume injecting or discharging until repairs of any failed structure are performed and tested as applicable. Repair procedures, methods, and materials used to restore the system(s) to proper operating condition shall be described in the facility log/recordkeeping file and available for ADEQ review. The facility log/recordkeeping file shall be maintained according to Section 2.7.2 (Operation Inspection / Log/Recordkeeping File).
7. Submit a written report within thirty days to ADEQ as specified in Section 2.7.3 (Permit Violation and AL Status Reporting) describing the incident and the corrective

actions taken. Upon review of the report, the Department may require an amendment to the permit to require surface, vadose zone or groundwater monitoring, require installation of additional POCs, increased frequency of monitoring, remedial actions, amendments to permit conditions or other actions.

8. Within 30 days of discovery, conduct an assessment of the impacts to the surface, vadose zone and/or groundwater resulting from the incident. If soil or groundwater is impacted, submit to ADEQ, for approval, a corrective action plan to address such impacts, including identification of remedial actions and/or monitoring, and a schedule for completion of activities. The corrective action plan shall be submitted within sixty days of the incident. At the direction of ADEQ, the permittee shall implement the approved plan.

#### **2.6.4 Aquifer Quality Limit Violation**

1. If an AQL for a pollutant specified in Section 4.1, Table 4.1-6 and Table 4.1-7, is exceeded in a POC Well, the permittee may conduct verification sampling for those pollutant(s) that were above their respective AQL(s) no later than five (5) days after learning of the violation. If verification sampling does not verify the violation, then the initial violation shall be reported in the Quarterly Monitoring and Compliance Report and no further action shall be required of the permittee for that event.
2. If verification sampling confirms the violation for those pollutant(s) that were above their respective AQL(s), or if the permittee opts not to perform verification sampling, then the permittee shall:
  - a. Notify ADEQ within five (5) days after confirming or learning of the violation, in accordance with Section 2.7.3;
  - b. Immediately initiate: (1) a BADCT systems evaluation for the cause of the violation, including an inspection of all facilities regulated under this permit and corresponding pollution control devices, and a review of any operational or maintenance practices that might have resulted in an unexpected discharge; and (2) a hydrogeologic assessment of the violation, including groundwater modeling, review of groundwater conditions and upgradient water quality, groundwater contours, and an inventory of downgradient well users and types of uses;
  - c. Increase the frequency of monitoring at the location of the violation to monthly for those pollutant(s) that exceeded their respective AQL(s);
  - d. Submit a written report based on the investigation within thirty (30) days after becoming aware of the violation, in accordance with Section 2.7.3; and
  - e. Take actions that may be necessary as a result of the violation under Section 2.6.5.
3. As part of its written report, the permittee may include a technical demonstration that the violation was not caused or contributed to by pollutants discharged from a facility regulated under this APP.
4. Based on the written report, ADEQ may, if necessary: (1) amend the permit to require increased frequency of monitoring or additional monitoring; and (2) authorize corrective action including measures to control the source of a discharge causing the violation (including BADCT correction if necessary); remediate affected soils, surface water or groundwater; and mitigate the impact of the violation on existing uses of the aquifer. ADEQ's corrective action authorization may be in the form of an approval under Section 2.6.6, an amendment of this permit or approval of a contingency plan.
5. If the violation continues for sixty (60) days, then the permittee shall notify downgradient or downstream users who may be directly affected by the violation.
6. If the violation continues for ninety (90) days, then the permittee shall prepare and submit for ADEQ approval a hydrogeologic investigation work plan within thirty (30) after receiving the laboratory results of the third sampling event. The work plan shall assess whether the violation is due to natural or anthropogenic causes and, if exceeded values are found to be related to APP-regulated facilities within the mine site or results are inconclusive, the nature and extent of the discharge. This hydrogeologic investigation shall become the basis of adjusting permit conditions and/or designing corrective action.

**2.6.5 Emergency Response and Contingency Requirements for Unauthorized Discharges pursuant to A.R.S. §49-201(12) and pursuant to A.R.S. § 49-241**

**2.6.5.1 Duty to Respond**

The permittee shall act immediately to correct any condition resulting from a discharge pursuant to A.R.S. § 49-201(12) if that condition could pose an imminent and substantial endangerment to public health or the environment.

**2.6.5.2 Discharge of Hazardous Substances or Toxic Pollutants**

In the event of any unauthorized discharge pursuant to A.R.S. § 49-201(12) of suspected hazardous substances (A.R.S. § 49-201(19)) or toxic pollutants (A.R.S. § 49-243(I)) on the facility site, the permittee shall promptly isolate the area and attempt to identify the discharged material. The permittee shall record information, including name, nature of exposure and follow-up medical treatment, if necessary, on persons who may have been exposed during the incident. The permittee shall notify the Groundwater Protection Value Stream within 24 hours upon discovering the discharge of hazardous material which (a) has the potential to cause an AWQS or AQL to be exceeded, or (b) could pose an endangerment to public health or the environment.

**2.6.5.3 Discharge of Non-hazardous Materials**

In the event of any unauthorized discharge pursuant to A.R.S. § 49-201(12) of non-hazardous materials from the facility, the permittee shall promptly attempt to cease the discharge and isolate the discharged material. Discharged material shall be removed and the site cleaned up as soon as possible. The permittee shall notify the ADEQ Groundwater Protection Value Stream within 24 hours upon discovering the discharge of non-hazardous material which (a) has the potential to cause an AQL to be exceeded, or (b) could pose an endangerment to public health or the environment.

**2.6.5.4 Reporting Requirements**

The permittee shall submit a written report for any unauthorized discharges reported under Sections 2.6.5.2 and 2.6.5.3 to ADEQ Groundwater Protection Value Stream within 30 days of the discharge or as required by subsequent ADEQ action. The report shall summarize the event, including any human exposure, and facility response activities and include all information specified in Section 2.7.3. If a notice is issued by ADEQ subsequent to the discharge notification, any additional information requested in the notice shall also be submitted within the time frame specified in that notice. Upon review of the submitted report, ADEQ may require additional monitoring or corrective actions.

**2.6.6 Corrective Actions**

Specific contingency measures identified in Section 2.6 and actions identified in the approved contingency plan to be submitted under the Compliance Schedule Section 3.0 have already been approved by ADEQ and do not require written approval to implement.

With the exception of emergency response actions taken under Section 2.6.5, the permittee shall obtain written approval from the Groundwater Protection Value Stream prior to implementing a corrective action to accomplish any of the following goals in response to exceeding an AL or violation of an AQL, DL, or other permit condition:

1. Control of the source of an unauthorized discharge;
2. Soil cleanup;
3. Cleanup of affected surface waters;
4. Cleanup of affected parts of the aquifer; and/or
5. Mitigation to limit the impact of pollutants on existing uses of the aquifer.

Within 30 days of completion of any corrective action, the permittee shall submit to the ADEQ Groundwater Protection Value Stream, a written report describing the causes, impacts, and actions taken to resolve the problem.

## **2.7 Reporting and Recordkeeping Requirements**

[A.R.S. § 49-243(K)(2) and A.A.C. R18-9-A206(B) and R18-9-A207]

### **2.7.1 Self-Monitoring Report Form (SMRF)**

1. When submitting a hard copy, the permittee shall complete the Self-monitoring Report Form (SMRF) provided by ADEQ including contact information for the person completing the form. Submit the completed form to the Groundwater Protection Value Stream.
2. The permittee shall complete the SMRF to the extent that the information reported may be entered on the form. If no information is required during a reporting period, the permittee shall enter "not required" on the SMRF and submit the report to the Groundwater Protection Value Stream. The permittee shall use the format devised by ADEQ.
3. The tables contained in Section 4.1 list the monitoring parameters and frequencies for reporting results on the SMRFs. The parameters listed in the following tables from Section 4.1-6 are the only parameters for which SMFR reporting is required:

Table 4.1-4 Leak Collection and Removal System Monitoring

Table 4.1-6 Quarterly Compliance Groundwater Monitoring

Table 4.1-6B Quarterly Operational Groundwater Monitoring

Table 4.1-7 Semi-Annual Compliance Groundwater Monitoring

Table 4.1-7B Semi-Annual Operational Groundwater Monitoring

Table 4.1-8 In-situ BADCT Monitoring

### **2.7.2 Operation Inspection / Log Book Recordkeeping**

A signed copy of this permit shall be maintained at all times at the location where day-to-day decisions regarding the operation of the facility are made. A log book (paper copies, forms or electronic data) of the inspections and measurements required by this permit shall be maintained at the location where day-to-day decisions are made regarding the operation of the facility. The log book shall be retained for ten years from the date of each inspection, and upon request, the permit and the log book shall be made immediately available for review by ADEQ personnel. The information in the log book shall include, but not be limited to, the following information as applicable:

1. Name of inspector;
2. Date and time inspection was conducted;
3. Condition of applicable facility components;
4. Any damage or malfunction, and the date and time any repairs were performed;
5. Documentation of sampling date and time;
6. Any other information required by this permit to be entered in the log book; and
7. Monitoring records for each measurement shall comply with R18-9-A206(B)(2).

### **2.7.3 Permit Violation and Alert Level Status Reporting**

1. The permittee shall notify the Groundwater Protection Value Stream in writing within 5 days (except as provided in Section 2.6.5) of becoming aware of a violation of any permit condition, discharge limitation or of an AL exceedance for which notification requirements are not specified in sections 2.6.2 through 2.6.5.
2. The permittee shall submit a written report to the Groundwater Protection Value Stream within 30 days of becoming aware of the violation of any permit condition or discharge limitation. The report shall document all of the following:
  - a. Identification and description of the permit condition for which there has been a violation

- and a description of its cause;
- b. The period of violation including exact date(s) and time(s), if known, and the anticipated time period during which the violation is expected to continue;
- c. Any corrective action taken or planned to mitigate the effects of the violation, or to eliminate or prevent a recurrence of the violation;
- d. Any monitoring activity or other information which indicates that any pollutants would be reasonably expected to cause a violation of an AWQS;
- e. Changes to the monitoring which include changes in constituents or increased frequency of monitoring; and
- f. Description of any malfunction or failure of pollution control devices or other equipment or processes.

## **2.7.4 Operational, Other or Miscellaneous Reporting**

### **2.7.4.1 Annual Report**

If an Alert Level #1 for Normal Liner Leakage has been exceeded as discussed in Section 2.6.2.2, the permittee shall submit an annual report that summarizes the results of the liner assessment. The Liner Leakage Assessment Report shall also include information including but not limited to the following: number and location of holes identified; a table summarizing the AL1 exceedances including the frequency and quantity of fluid removed, and corrective actions taken. The annual report shall be submitted prior to 30 days of expiration of this permit.

### **2.7.4.2 Ambient Mine Block Concentration Report**

Ambient mine block groundwater concentrations are required to be determined in order to establish mine block closure rinsing requirements identified Section 2.9.1. One sample shall be taken from each mine block well in order to establish ambient groundwater concentrations. The permittee shall submit the ambient mine block groundwater concentrations in accordance with the Compliance Schedule in Section 3.0.

### **2.7.4.3 Required Pre-Operational Report**

The permittee shall submit the results obtained from the aquifer pump tests using the outermost recovery wells located at the four corners of the PTF well field in and around the PTF and with a minimum of at least three other wells to be monitored in accordance with the Compliance Schedule (Section 3.0). The Aquifer Pump Test Report shall discuss and evaluate the feasibility of the proposed Pilot Test using data obtained from pump tests at the PTF wells. The evaluation shall verify previously calculated aquifer properties such as hydraulic conductivity, transmissivity, groundwater velocity, etc. and the validity of the porous medium assumption used in the groundwater modeling for the oxide unit. The aquifer pump test report shall also include, at a minimum: all of the data generated during the aquifer tests, description of the aquifer tests, which analytical methods were used to analyze the aquifer test data, description of why those methods were chosen, input and output reports from the chosen aquifer test software.

The report shall include initial Underground Workings ambient discharge characterization as required in Section 2.5.1.

The report shall also include the evaluation of inward gradient during start-up of the nine recovery wells and injection of Oxide Unit water from the four injection wells. The report shall include, at a minimum: potentiometric groundwater contour maps and evaluation of the potentiometric contour maps for cone of depression as required in Section 2.2.3(f) and the Compliance Schedule in Section 3.0.

The report shall include a description of the well abandonment required in Section 2.2.3. The report shall include the information required in Section 2.7.4.5 and the Compliance



## Schedule in Section 3.0.

The report shall also include well installation details for all Injection, Recovery, Multi-port, Observation, Supplemental, MW-01 and POC wells in accordance with A.A.C. R12-15-801 et seq. and consist of the following:

- Copies of ADWR Notice of Intent (NOI) and all related submittals to ADWR;
- Boring log and well as-built diagram;
- Total depth of well measured after installation;
- Top of well casing or sounding tube (whichever is used as the fixed reference measuring point) and ground surface elevation;
- Depth to static groundwater;
- Geophysical logging reports and subsurface sampling results, if any;
- Description of well drilling method;
- Description of well development method;
- If dedicated sampling equipment installed, details on the equipment and at what depth the equipment was installed;
- Summary of analytical results for initial groundwater sample collected after installation;
- Corresponding analytical data sheets; and
- Global Positioning System (GPS) coordinates for each new well;
- Any deviations from original proposed construction or location.

**2.7.4.4 PTF Operations and Monitoring Quarterly Reports**

The permittee shall submit quarterly reports concerning the operations and monitoring of the PTF during the 14-month mining and 9-month rinsing phase to the ADEQ Groundwater Protection Value Stream. Quarterly reports shall be submitted no later than 30 days following the end of each calendar quarter. The quarterly report shall demonstrate whether the hydraulic control was maintained at the PTF during the quarterly monitoring period. Hydraulic control shall be demonstrated by, including but not limited to, the following: maintaining a cone of depression that extends to the PMA boundary associated with the PTF well field by pumping more solution out than went in, maintaining a 1-foot difference between pairs of injection and observation wells within the PTF well field, maintaining the fracture gradient, and compliance with ALs and AQLs at the POCs. The report shall include:

1. A graphical representation of the volumes extracted and injected used to maintain hydraulic control. In the event that more solution was injected than recovered for a 24-hour period, or in the event that any of the instruments used to measure the flow volumes malfunction or are out of service for more than 24 consecutive hours, the permittee shall submit a report showing for each day of the quarterly reporting period, the hydraulic gradient was maintained.
2. A graphical representation that a continuous inward hydraulic gradient was maintained using water level elevations in the PTF. The reports shall include a graphical presentation of head comparisons for each pair of observation and recovery wells used to monitor the hydraulic gradient. The report shall also include a figure showing the location and identity of each of the paired wells. In the event any one of the well pairs indicate less than 1-foot differential between observation and recovery wells, or in the event that any of the instruments used to measure the hydraulic gradient malfunction or are out of service for more than 24 consecutive hours, the permittee shall submit a report showing for each day of the quarterly reporting period, the daily flow into and out of the mine block. Inward hydraulic gradient shall also be demonstrated through the submittal of potentiometric groundwater contour maps which depict the monthly minimum, monthly average and monthly maximum inward hydraulic gradient toward the recovery wells using groundwater elevations collected at the PTF well field.
3. Provide the three monthly potentiometric surface maps and provide a description of

- the cone of depression for the quarter.
4. Provide a report to include the LBFU bulk electrical conductivity contour maps and a description of their interpretation. The report shall be sealed by an appropriate Arizona Registrant.
  5. A summary of pressure transducers readings and fracture gradients readings.
  6. A graphical representation of electric conductivity readings from the injection and observation wells.
  7. A description of any deviations from standard sampling protocols during the reporting period.
  8. A summary of all exceedances of ALs, AQLs, Action Levels, DLs, or operational limits that occurred during the reporting period and provide the contingency actions completed to mitigate the effects of the violation, or to eliminate the recurrence of the exceedance or violation. The report shall also include identification and discussion of any laboratory results that fell outside of the laboratory QA/QC criteria and AQLs and ALs required by this permit.
  9. Graphical time versus concentration plots of groundwater elevations, field pH, sulfate, and total dissolved solids since the inception of monitoring at each POC well, and any parameter which exceeded an applicable AL or AQL in the past three sampling events at each POC well.
  10. Groundwater elevation contour maps for each quarterly monitoring period, including the groundwater elevation obtained from the underground workings. The contour maps shall identify, if known, any wells that were pumping within a half-mile radius of the PTF.
  11. Results of the discharge characterization of the underground working, if the required sampling event falls within the quarterly reporting period.
  12. Fissure inspection summary for the reporting period.
  13. An updated table of all monitor wells in the Discharge Impact Area including, but not limited to, location of well, depth of well, depth to water, and water level elevation.
  14. A summary of any groundwater monitor wells replaced in the reporting period including, but not limited to, location of well, depth of well, depth to water, water level elevation, and screened interval.
  15. Groundwater sampling results for the POCs, and BADCT Monitor Wells.
  16. Copies of Reports submitted to the EPA as required by the UIC permit, including groundwater monitoring results from wells not covered by this permit.

#### **2.7.4.5 Well Abandonment Reports**

If wells associated with this permit are abandoned due to poor performance, casing collapse, or other reasons, or are abandoned at the end of the post-closure period, then within 90 days of completing abandonment, the permittee shall submit a well abandonment report to ADEQ Groundwater Protection Value Stream. Appropriate contents of the report shall be sealed by an Arizona professional geologist or professional engineer, in accordance with Arizona Board of Technical Registration requirements. Well abandonment records shall be provided to ADEQ within 90 days of monitor well abandonment and shall include:

1. Copies of ADWR Notice of Intent to Abandon
2. Copies of ADWR Abandonment Reports
3. A description of the methods used to seal the well casing and the perforated or screened interval of the well; and
4. Global Positioning System (GPS) coordinates of the former well location

#### **2.7.4.6 Ambient Groundwater Quality Report**

Completed.

#### **2.7.4.7 LBFU Bulk Ambient Electrical Conductivity Report**

Completed.

#### 2.7.5 Reporting Location

All SMRFs shall be submitted to:

Arizona Department of Environmental Quality  
Groundwater Protection Value Stream  
Mail Code: 5415B-3  
1110 W. Washington Street  
Phoenix, AZ 85007  
Phone (602) 771-4571

Or

Through the myDEQ portal accessible on the ADEQ website at:  
<http://www.azdeq.gov/welcome-mydeq>

All documents required by this permit to be submitted to the Groundwater Protection Value Stream shall be directed to:

Arizona Department of Environmental Quality  
Groundwater Protection Value Stream  
Mail Code: 5415B-3  
1110 W. Washington Street  
Phoenix, AZ 85007  
Phone (602) 771-4999

#### 2.7.6 Reporting Deadline

The Quarterly Report required by Section 2.7.4 and the results of monitoring conducted during each quarter is due within 15 days of the end of the 1<sup>st</sup> quarter and every quarter thereafter. The effective date of the permit shall be used for the purpose of determining the beginning of the 1<sup>st</sup> quarter to begin monitoring and reporting.

The following table lists the report due dates<sup>1</sup>

Monitoring conducted during:	Quarterly Report due by:
First Quarter: January-March	April 30
Second Quarter/Semi-Annual: April-June	July 30
Third Quarter: July-September	October 30
Fourth Quarter/Annual: October-December	January 30

<sup>1</sup>A post-mark date no later than the due date is considered meeting the due date requirements under this Section.

#### 2.7.7 Changes to Facility Information in Section 1.0

The Groundwater Protection Value Stream shall be notified within 10 days of any change of facility information including Facility Name, Permittee Name, Mailing or Street Address, Facility Contact Person or Emergency Telephone Number.

#### 2.8 Temporary Cessation [A.R.S. § 49-243(K)(8) and A.A.C. R18-9-A209(A)]

The permittee shall give written notice to the Groundwater Protection Value Stream before ceasing operation of the facility for a period of 60 days or greater. The permittee shall take the following measures upon temporary cessation:

Immediately following ADEQ's approval, the permittee shall implement the approved plan. If the permittee

intends to permanently cease operation of any facility, the permittee shall submit closure notification, as set forth in Section 2.9 below.

Submittal of Self-Monitoring Report Forms (SMRFs) is still required; report "temporary cessation" in the comment section.

At the time of notification the permittee shall submit for ADEQ approval a plan for maintenance of discharge control systems and for monitoring during the period of temporary cessation. Immediately following ADEQ's approval, the permittee shall implement the approved plan. If necessary, ADEQ shall amend permit conditions to incorporate conditions to address temporary cessation. During the period of temporary cessation, the permittee shall provide written notice to the Groundwater Protection Value Stream of the operational status of the facility every ninety days. If the permittee intends to permanently cease operation of any facility, the permittee shall submit closure notification, as set forth in Section 2.9 below.

## **2.9 Closure [A.R.S. §§ 49-243(K)(6), 49-252 and A.A.C. R18-9-A209(B)]**

For a facility addressed under this permit, the permittee shall give written notice of closure to the Groundwater Protection Value Stream of the permittee's intent to cease operation without resuming activity for which the facility was designed or operated, or submit an amendment application to incorporate the discharging facilities under this permit into the current individual permit (Inventory Number P-101704, LTF Number 53498, dated August 12, 2011). Submittal of SMRFs is still required: report "closure in process" in the comment section.

### **2.9.1 Closure Plan**

Within 90 days of the effective date of this permit, the permittee shall submit for approval to the Groundwater Protection Value Stream, a Closure Plan which meets the requirements of A.R.S. § 49-252 and A.A.C. R18-9-A209(B)(3) and includes the following topics:

1. Updated closure and post-closure financial requirements.
2. Contingency mine block rinsing and sampling, as needed.
3. Confirmation PTF mine block sampling requirements after the completion of the pilot test.
4. Confirmation underground workings sampling requirements after the completion of the pilot test.
5. Outline of Report contents for PTF Summary Report that incorporates updated groundwater modeling at the cessation of the pilot test.
6. An initial 5 year post-closure groundwater monitoring period, with an evaluation to complete additional post-closure monitoring.
7. 5 Year Post-Closure Groundwater Monitoring Report that incorporates updated groundwater modeling.

### **2.9.2 PTF Mine Block Closure**

The permittee will commence PTF closure after the pilot test mining phase has ceased. During mine block closure operations, the permittee will cease the injection of raffinate, and will initiate a mine block rinsing program consisting of the injection of formation water and neutralization agents. At all times during initial block rinsing, the permittee will maintain hydraulic control by sustaining an inward hydraulic gradient within the mine block. The permittee will monitor the rinsing progress by analyzing the water recovered from well-field headers for sulfate concentration. When levels of sulfate in the headers have reached approximately 750 parts per million (ppm), the permittee will sample the injection well header discharges for constituents listed in Section 4.1 Table 4.1-7. If the results of the sampling show concentrations of parameters greater than the AWQS and or greater than the pre-determined mine block concentrations, then rinsing operations will continue until all compounds are below primary MCLs or AWQS or predetermined AWQS mine block concentrations.

The permittee will sample all of the wells in the mine block undergoing closure to determine if the sulfate concentrations are less than 750 ppm and the pH is above 5.0 S.U. The permittee will

continue rinsing each well until such time that the sulfate concentration in the well is less than 750 ppm and the pH is above 5 S.U.

When all individual well sulfate concentrations in the mine block are less than 750 ppm and a pH is above 5.0 S.U., hydraulic control will be discontinued for 30 days. At the end of the 30-day period, the headers will be re-sampled and if sulfate concentrations remain below 750 ppm and pH remains above 5.0 S.U., the permittee may cease all rinsing activities within the PTF. All POC wells will continue to be monitored in accordance with Section 2.5.3.2 and 2.5.3.3.

A confirmation groundwater sample of the PTF mine block wells will be required at a one month period, six month period and at the one year increment after the groundwater rinsing has ceased to measure any rebound effects to mine block contaminant concentrations for constituents listed in Section 4.1, Table 4.1-7. The results of the confirmation mine block sampling shall be submitted to ADEQ Groundwater Protection Value Stream within 30 days of receiving the laboratory analytical results. The permittee shall amend APP P-101704 to incorporate the required mine block closure confirmation sampling which extends beyond the permitted time frames allowed by the Temporary APP pilot project.

The PTF mine block wells shall be abandoned in accordance with ADWR and UIC regulations. EPA and ADEQ written approval shall be obtained prior to abandoning PTF mine block wells.

**2.10 Post-closure [A.R.S. §§ 49-243(K)(6), 49-252 and A.A.C. R18-9-A209(C)]**

Post-closure requirements shall be established based on the approval of Closure Plan submitted to ADEQ per Section 2.9.1.

**3.0 COMPLIANCE SCHEDULE [A.R.S. § 49-243(K)(5) and A.A.C. R18-9-A208]**

For each compliance schedule item listed below, the permittee shall submit the required information, including a cover letter that lists the compliance schedule items, to the Groundwater Protection Value Stream.

**Submittals/Activities Not Requiring Permit Amendments**

	<b>Description</b>	<b>Comments</b>	<b>Due Date</b>
1	Permittee shall submit a copy of signed, dated and sealed as-built drawings along with QA/QC documentation to confirm that all discharging facilities were constructed in accordance with the design report, engineering plans and specifications, and other associated data and information approved by ADEQ.	Completed	Within 60 days of completion of construction of the PTF
2	Permittee shall submit a copy of the Pre-Operational Report as required in Section 2.7.4.3 for ADEQ approval.	Completed	At least 30 days prior to beginning operation of the PTF
3	Permittee shall submit ambient mine block groundwater concentrations for the PTF wells in accordance with Section 2.7.4.2.	Completed	Within 30 days of completion of ambient mine block sampling
4	Permittee shall submit an updated contingency and emergency response plan that complies with the requirements of Arizona Administrative Code R18-9-A204.	Completed	Within 30 days of the effective date of the permit (See Section 1.0)
5	Permittee shall conduct initial discharge characterization for parameters listed in Section 4.1, Table 4.1-2C for the PLS Tank, Raffinate Tank, Process Water Impoundment, and Run-off Pond as required by Section 2.5.1.	Completed	Within 120 days of start-up of the PTF
6	Permittee shall submit initial discharge characterization results for the PLS Tank, Raffinate Tank, Process Water Impoundment, and Run-off Pond as required by Section 2.5.1 and shall be submitted to the Groundwater Protection Value Stream.	Completed	Within 30 days of receipt of the laboratory analytical results
7	Permittee shall submit renewal application for this permit.	Completed	Within 60 days prior to the end of the initial year of this permit's effective date
8	Permittee shall submit a closure plan for all discharging facilities permitted under this Temporary Individual Permit in accordance with Section 2.9.1.	Completed	Within 90 days of the effective date of the permit (See Section 1.0)
9	Permittee shall install POC wells and Supplemental Wells in accordance with all Arizona Department of Water Resources (ADWR) requirements	Completed	Prior to the aquifer pump tests required by Section 2.2.3



	Description	Comments	Due Date
10	Permittee shall submit a proposal for the location of monitor well MW-01 in accordance with Section 2.5.8.1.	Completed	Within 14 days of completion of aquifer pump test analysis.
11	Permittee shall install Monitor Well MW-01	Completed	Within 30 days of ADEQ approval of the location of MW-01
12	Permittee shall initiate Ambient Water Quality Monitoring for POC wells M54-LBF, M54-O and M52-UBF, Supplemental and Operational Monitoring Well MW-01. The samples shall be analyzed for all of the parameters listed in Table 4.1-5	Completed	Within 14 days of completing well development for Supplemental wells and MW-01

### Submittals/Activities Requiring Permit Amendment Applications

	Description	Comments	Due Date
13	Permittee shall submit an Ambient Monitoring Report to include: Calculated alert levels for arsenic (see Section 2.5.7); ALs and AQLs for POC wells, ALs for Supplemental Wells and MW-01 as required in Section 2.7.4.6, and; LBFU ambient Bulk Electrical Conductivity report as required in Section 2.5.9.1 and Section 2.7.4.7.	Completed	No later than 90 days prior to PTF operation
14	Permittee shall submit an amendment application to incorporate all discharging facilities, and all closure/post-closure activities in accordance with an ADEQ approved Closure Plan per Section 2.9.1 and 2.9.2 from APP P-106360 into APP P-101704. The application shall also include updated closure/post-closure cost estimates for APP P-101704 and a corresponding updated financial assurance mechanism for APP P-101704.	Completed	Within 180 days of the effective date of this permit (See Section 1.0)

#### **4.0 TABLES OF MONITORING REQUIREMENTS**

##### **4.1 OPERATIONAL MONITORING (or CONSTRUCTION REQUIREMENTS)**

Table 4.1-1 Permitted Facilities and BADCT

Table 4.1-2A One-time Sampling Event-Discharge Monitoring Locations

Table 4.1-2B Multiple Sampling Event-Discharge Monitoring Location

Table 4.1-2C Discharge Monitoring Sampling Parameters

Table 4.1-3 Required Inspections and Operational Monitoring

Table 4.1-4 Leak Collection and Removal System Monitoring

Table 4.1-5 Parameters for Ambient Groundwater Monitoring

Table 4.1-6 Quarterly Compliance Groundwater Monitoring

Table 4.1-6B Quarterly Operational Groundwater Monitoring

Table 4.1-7 Semi-Annual Compliance Groundwater Monitoring

Table 4.1-7B Semi-Annual Operational Groundwater Monitoring

Table 4.1-8 In-situ BADCT Monitoring

**Table 4.1-1  
Permitted Facilities and BADCT**

<b>Facility Name</b>	<b>Latitude/Longitude</b>	<b>Facility BADCT</b>
In-Situ Area Injection and Recovery Well Block	33° 3' 1.39" N/111° 26' 4.69" W	Design, construction, testing (mechanical integrity), and operation of injection and recovery wells shall follow EPA Class III rules (40 CFR Part 146). The maximum injection <i>rate</i> shall be no greater than 60 gallons per minute (gpm) per injection well as a monthly average. The maximum <i>fracture pressure</i> shall be no greater than 0.65 pounds per square inch per foot (psi/ft) of depth. Hydraulic control shall be maintained at all times, within the PTF well block, by pumping recovery wells at a rate greater than the injection rate in order to maintain a cone of depression that extends at least 500 feet from the in-situ area injection and recovery well block. The injection and extraction volumes shall be metered at the well-heads, monitored daily, and recorded. All boreholes or wells, other than those approved for the PTF, located within 500-feet of the PTF well field boundary shall be plugged and abandoned per the Arizona Department of Water Resources (ADWR) rules and EPA Underground Injection Control (UIC) regulations prior to PTF operation. During closure of the PTF all operational wells shall be plugged and abandoned per the above regulations.
Process Water Impoundment (PWI)	33° 3' 8.67" N/111° 25' 22.18" W	The PWI will have a capacity of approximately 1.7 million cubic feet, approximately 15 to 23-feet deep, with internal and external side slopes of 2.5-feet horizontal to 1.0-feet vertical (2.5H:1V) ), and maintain a minimum of two (2) feet freeboard. The PWI will be designed as a double liner system and includes a leak collection and removal system (LCRS). The liner system consists of, from bottom to top; a compacted sub-grade (foundation) with liner bedding, 60-mil HDPE secondary liner, geonet, and 60-mil primary liner. The LCRS will be equipped with a sump located at the lowest elevation of the pond; a sump pump to remove accumulated liquids; and an alarm system for fluid detection.
Run-off Pond	33° 3' 4.66" N/111° 25' 22.6" W	The Runoff Pond will have a capacity of approximately 6,583 cubic feet; the pond depth will be approximately 5-feet deep but will vary; internal and external side slopes will be no less than 2.0-feet horizontal to 1.0-feet vertical (2.5H:1V); and pond shall maintain two (2) feet of freeboard. The Runoff Pond will be designed with a single liner that includes an engineered compacted sub-grade and 60-mil HDPE geomembrane liner. The Runoff Pond will incorporate a sump with pump along with fluid-level detection equipment. When fluid is detected above the level set-point the pump will transfer fluid out of the Runoff Pond to the Water Impoundment per pipeline.

<b>TABLE 4.1-2A</b> <b>One-time Sampling Event-Discharge Monitoring Locations</b>			
<b>Sampling Point Number</b>	<b>Facility</b>	<b>Latitude</b>	<b>Longitude</b>
001	PLS Tank	33° 03' 4.26"	111° 25' 19.50"
002	Raffinate Tank	33° 03' 4.05"	111° 25' 19.68"
003	Process Water Impoundment	33° 03' 8.67"	111° 25' 22.18"
004	Runoff Pond	33° 03' 4.66"	111° 25' 22.6"

<b>TABLE 4.1-2B</b> <b>Multiple Sampling Event-Discharge Monitoring Location</b>			
<b>Sampling Point Number</b>	<b>Facility</b>	<b>Latitude</b>	<b>Longitude</b>
005	Underground workings – Main Shaft	33° 03' 4.13"	111° 25' 45.07"

<b>Table 4.1-2C</b> <b>Discharge Monitoring Sampling Parameters (in mg/L unless otherwise noted)</b>		
pH – field & lab (SU)	Sodium	Nickel
Specific Conductance - field and lab (µmhos/cm)	Iron	Selenium
Total Dissolved Solids	Aluminum	Thallium
Total Alkalinity	Antimony	Zinc
Carbonate	Arsenic	Gross Alpha Particle Activity (pCi/L) <sup>1</sup>
Bicarbonate	Barium	Radium 226 + Radium 228 (pCi/L)
Nitrate	Beryllium	Uranium-Isotopes (pCi/L) <sup>2</sup>
Sulfate	Cadmium	Total Petroleum Hydrocarbons
Chloride	Chromium	Benzene
Fluoride	Cobalt	Toluene
Calcium	Copper	Ethylbenzene
Ammonia	Lead	Total Xylenes
Magnesium	Manganese	Uranium, Total (µg/L)
Potassium	Mercury	

1. The adjusted gross alpha particle activity is the gross alpha particle activity, including radium 226, and any other alpha emitters, if present in the water sample, minus radon and total uranium (the sum of uranium 238, uranium 235 and uranium 234 isotopes). The gross alpha analytical procedure (evaporation technique: EPA Method 900.0) drives off radon gas in the water samples. Therefore, the Adjusted Gross Alpha should be calculated using the following formula: (Laboratory Reported Gross Alpha MINUS Sum of the Uranium Isotopes).
2. Uranium Isotope activity results must be used for calculating Adjusted Gross Alpha. No SMRF reporting is required.

NOTE: Metals shall be analyzed as dissolved metals.

Table 4.1-3 Required Inspections and Operational Monitoring			
Facility Category	Facility Name	Operational Requirements	Inspection Frequency
Process Solution Impoundment	Process Water Impoundment	-Maintain 2 feet of freeboard; -all discharge and sump pumps operational; -no substantial erosion, subsidence, cracking, -no evidence of seepage or other damage to berms; -no visible cracks or damage to liner; -full access to leak detection system maintained.	Daily
Lined Non-stormwater Containment Pond	Run-off Pond	-Maintain 2 feet of freeboard; -Spillway clear of sediment or obstructions; -no visible cracking or damage to liner; -no operational damage to enclosure wall; -all pumps operational; -backup power supply operational; -no ponding of spilled material in pond and sumps; -sediment deeper than 1 inch deep removed from sumps; -fluids in sumps maintained at less than pump-down levels.	Weekly
Storm water control structures	Site-wide - stormwater ditches	-No substantial erosion or structural damage; -maintained free of sediments, vegetation or obstructions.	Monthly
Groundwater Monitoring Wells	Site-wide - monitoring wells	Wellhead cap or box locks are observed to be secure.	Quarterly, as sampled
Pumps	Site-wide - Barge Pumps, Run-Off Transfer Pumps, Sump Pumps, Discharge Pumps	Check hour meters; -visual inspection for leaks. -Lubrication  -Maintenance and test run.	Weekly  Per manufacturers specification Every 1,000 to 1,200 hours of operation
In-Situ Area Injection and Recovery Well Block	Well Field	No leakage from pipelines, manifolds or well heads.	Daily
In-Situ Area Injection and Recovery Well Block	Well Field	Initiate subsidence/fissure monitoring program.	Quarterly

<b>Table 4.1-4</b>					
<b>Leak Collection and Removal System Monitoring</b>					
<b>Facility Name</b>	<b>Alert Level #1 (GPD)</b>	<b>Alert Level #2 (GPD)</b>	<b>Monitoring Method</b>	<b>Monitoring Frequency</b>	<b>Reporting Frequency</b>
Process Water Impoundment	2,040	16,250	Automated	Daily	Annual

GPD = gallons per day per wetted acre

Note: The Alert Level 1 (AL1) or Alert Level 2 (AL2) shall be exceeded when the amount of leakage pumped from the sump for the evaporation pond is greater than the applicable quantity below. Contingency requirements of Sections 2.6.2.3 shall be followed for AL1 and AL2 exceedances, respectively. An exceedance of AL 1 or AL2 is not a violation of the permit unless the permittee fails to perform actions as required under the Sections referenced above

<b>Table 4.1-5</b>		
<b>Parameters for Ambient Groundwater Monitoring (in mg/L unless otherwise noted)</b>		
Depth to Water Level (feet)	Potassium	Nickel
Water Level Elevation (feet amsl)	Sodium	Selenium
Temperature- field (°F)	Iron	Thallium
pH – field & lab (SU)	Aluminum	Zinc
Specific Conductance- field & lab (µmhos/cm)	Antimony	Free Cyanide
Total Dissolved Solids	Arsenic	Adjusted Gross Alpha (pCi/L) <sup>1</sup>
Total Alkalinity	Barium	Radium 226 (pCi/L)
Bicarbonate	Beryllium	Radium 228 (pCi/L)
Carbonate	Cadmium	Uranium-Isotopes(pCi/L) <sup>2</sup>
Hydroxide	Chromium	Carbon Disulfide
Sulfate	Cobalt	Benzene
Chloride	Copper	Toluene
Fluoride	Lead	Ethylbenzene
Nitrate + Nitrite	Manganese	Total Xylenes
Calcium	Mercury	Uranium, Total (µg/L)
Magnesium	Molybdenum	

1. The adjusted gross alpha particle activity is the gross alpha particle activity, including radium 226, and any other alpha emitters, if present in the water sample, minus radon and total uranium (the sum of uranium 238, uranium 235 and uranium 234 isotopes). The gross alpha analytical procedure (evaporation technique: EPA Method 900.0) drives off radon gas in the water samples. Therefore, the Adjusted Gross Alpha should be calculated using the following formula: (Laboratory Reported Gross Alpha MINUS Sum of the Uranium Isotopes).
2. Uranium Isotope activity results must be used for calculating Adjusted Gross Alpha. No SMRF reporting is required.

NOTE: Metals must be analyzed as dissolved metals.



**TABLE 4.1-6**  
**Quarterly Compliance Groundwater Monitoring (in mg/L unless otherwise noted)**

Parameter	POC Well # M14-GL		POC Well # M15-GU		POC Well # M22-O		POC Well # M23-UBF	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Depth to Groundwater (ft bgs)	Monitor <sup>1</sup>	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH- field (S.U.)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Specific Conductance- field (µmhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature- field (°F)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	4.0	3.2	4.0	3.2	4.0	3.2	4.0	3.2
Magnesium	Monitor	23	Monitor	44	Monitor	8.6	Monitor	69
Sulfate	Monitor	144	Monitor	126	Monitor	86	Monitor	411
Total dissolved solids	Monitor	874	Monitor	1,359	Monitor	1,094	Monitor	2,392

Parameter	POC Well #M54-LBF		POC Well # M54-O		POC Well # M52-UBF	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Depth to Groundwater (ft bgs)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH- field (S.U.)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Specific Conductance- field (µmhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature- field (°F)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	4	3.2	4	3.2	4	3.2
Magnesium	Monitor	46	Monitor	11	Monitor	45
Sulfate	Monitor	329	Monitor	200	Monitor	351
Total dissolved solids	Monitor	1731	Monitor	855	Monitor	1666

1. Monitor = Monitoring required, but no AQL or AL will be established in the permit.

<b>Table 4.1-6B</b>				
<b>Quarterly Operational Groundwater Monitoring</b>				
<b>Parameter</b>	<b>Supplemental Well M55-UBF</b>	<b>Supplemental Well M56-LBF</b>	<b>Supplemental Well M57-O</b>	<b>Supplemental Well M58-O</b>
	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>
Depth to Groundwater (ft. bgs)	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor
pH (field) (S.U.)	Monitor	Monitor	Monitor	Monitor
Specific Conductance (field) (mhos/cm)	Monitor	Monitor	Monitor	Monitor
Temperature (field)	Monitor	Monitor	Monitor	Monitor
Fluoride	3.2	3.2	3.2	3.2
Magnesium	50	46	20	59
Sulfate	484	312	200	435
Total Dissolved Solids	1900	1646	934	1716

<b>Parameter</b>	<b>Supplemental Well M59-O</b>	<b>Supplemental Well M60-O</b>	<b>Supplemental Well M61-LBF</b>	<b>Operational Monitor Well MW-01-LBF</b>	<b>Operational Monitor Well MW-01-O</b>
	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>	<b>AL (mg/L)</b>
Depth to Groundwater (ft. bgs)	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor
pH (field) (S.U.)	Monitor	Monitor	Monitor	Monitor	Monitor
Specific Conductance (field) (mhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature (field)	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	3.2	3.2	3.2	3.2	3.2
Magnesium	27	54	13	47	48
Sulfate	234	313	200	340	254
Total Dissolved Solids	947	1492	852	1711	1563
	<i>AL = Alert Level</i> <i>ft amsl = feet above mean sea level</i> <i>ft bgs = feet below ground surface</i> <i>mg/L = milligrams per liter</i> <i>mhos/cm = mhos per centimeter</i> <i>S.U. = Standard Units</i>				

**TABLE 4.1-7**  
**Semi-Annual Compliance Groundwater Monitoring (in mg/L unless otherwise noted)**

Parameter <sup>1</sup>	POC Well # M14-GL		POC Well # M15-GU		POC Well # M22-0		POC Well M23-	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Depth to Groundwater (ft bgs)	Monitor <sup>2</sup>	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH- field (S.U.)		Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Specific Conductance field (µmhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature- field(°F)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH (lab)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Bicarbonate	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Calcium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Carbonate	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Chloride	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	4.0	3.2	4.0	3.2	4.0	3.2	4.0	3.2
Magnesium	Monitor	23	Monitor	44	Monitor	8.6	Monitor	69
Nitrate as nitrogen	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Potassium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Sodium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Sulfate	Monitor	144	Monitor	126	Monitor	86	Monitor	411
Total dissolved solids	Monitor	874	Monitor	1359	Monitor	1094	Monitor	2392
Cation/anion balance	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Aluminum	Monitor	0.71	Monitor	0.71	Monitor	0.71	Monitor	0.71
Antimony	0.006	0.0048	0.006	0.0048	0.0076	Monitor	0.006	0.0048
Arsenic <sup>3</sup>	0.05	0.026	0.05	0.026	0.05	0.026	0.05	0.026
Barium	2.0	1.6	2.0	1.6	2.0	1.6	2.0	1.6
Beryllium	0.004	0.0032	0.0043	0.0032	0.004	0.0032	0.004	0.0032
Cadmium	0.005	0.004	0.02	Monitor	0.02	Monitor	0.005	0.004
Chromium (total)	0.10	0.08	0.10	0.08	0.10	0.08	0.10	0.08
Cobalt	Monitor	0.005	Monitor	0.005	Monitor	0.005	Monitor	0.005
Copper	Monitor	0.51	Monitor	0.51	Monitor	0.51	Monitor	0.51
Iron (total)	Monitor	2.2	Monitor	2.2	Monitor	2.2	Monitor	2.2
Lead	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04

**TABLE 4.1-7 Semi-Annual Compliance Groundwater Monitoring (in mg/L unless otherwise noted)**

Parameter	POC Well # M14-GL (Continued)		POC Well # M15-GU (Continued)		POC Well # M22-O (Continued)		POC Well # M23-UBF (Continued)	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Manganese	Monitor	0.22	Monitor	0.22	Monitor	0.22	Monitor	0.22
Mercury	0.002	0.0016	0.002	0.0016	0.002	0.0016	0.002	0.0016
Nickel	0.1	0.08	0.1	0.08	0.1	0.08	0.10	0.08
Selenium	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04
Thallium	0.002	0.0016	0.002	0.0016	0.01	Monitor	0.012	Monitor
Zinc	Monitor	2.5	Monitor	2.5	Monitor	2.5	Monitor	2.5
Adjusted Gross Alpha <sup>4</sup> (pCi/L)	15	12	15	12	15	12	15	12
Radium 226 + 228 (pCi/L)	5	4	5	4	5	4	5	4
Uranium Isotopes <sup>5</sup> (pCi/L)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Uranium, Total (µg/L)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Total petroleum hydrocarbons- diesel	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Benzene	0.005	0.004	0.005	0.004	0.005	0.004	0.005	0.004
Ethylbenzene	0.7	0.56	0.7	0.56	0.7	0.56	0.7	0.56
Toluene	1.0	0.08	1.0	0.08	1.0	0.08	1.0	0.08
Total Xylene	10	8	10	8	10	8	10	8

1. Metals must be analyzed as dissolved metals.
2. Monitor = Monitoring required, but no AQL or AL will be established in the permit.
3. The Alert Level for Arsenic is a narrative standard that is applied in order to protect downgradient users and will be revised, as necessary, in accordance with Section 2.5.7 and Section 3.0 to ensure that the UPL of 0.01 mg/L is not exceeded at the downgradient edge of the State Mineral Lease Land.
4. If the gross alpha particle activity is greater than the AL or AQL, then calculate the adjusted gross alpha particle activity. The adjusted gross alpha particle activity is the gross alpha particle activity, including radium 226, and any other alpha emitters, if present in the water sample, minus radon and total uranium (the sum of uranium 238, uranium 235 and uranium 234 isotopes). The gross alpha analytical procedure (evaporation technique: EPA Method 900.0) drives off radon gas in the water samples. Therefore, the Adjusted Gross Alpha should be calculated using the following formula: (Laboratory Reported Gross Alpha MINUS Sum of the Uranium Isotopes).
5. Uranium Isotope activity results must be used for calculating Adjusted Gross Alpha.

**TABLE 4.1-7 Semi-Annual Compliance Groundwater Monitoring (in mg/L unless otherwise noted)**

Parameter <sup>1</sup>	POC Well # M54-LBF		POC Well #M54-0		POC Well # M52-UBF	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Depth to Groundwater (ft bgs)	Monitor <sup>2</sup>	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH- field) (S.U.)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Specific conductance - field) (µmhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature -field(°F)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
pH (lab)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Bicarbonate	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Calcium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Carbonate	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Chloride	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	4	3.2	4	3.2	4	3.2
Magnesium	Monitor	46	Monitor	11	Monitor	45
Nitrate as nitrogen	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Potassium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Sodium	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Sulfate	Monitor	329	Monitor	200	Monitor	351
Total dissolved solids	Monitor	1731	Monitor	855	Monitor	1666
Cation/anion balance	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Aluminum	Monitor	0.16	Monitor	0.16	Monitor	0.16
Antimony	0.006	0.0048	0.006	0.0048	0.006	0.0048
Arsenic <sup>3</sup>	0.05	0.026	0.05	0.026	0.05	0.026
Barium	2	1.6	2	1.6	2	1.6
Beryllium	0.004	0.0032	0.004	0.0032	0.004	0.0032
Cadmium	0.005	0.004	0.005	0.004	0.005	0.004
Chromium (total)	0.1	0.08	0.1	0.08	0.1	0.08
Cobalt	Monitor	0.002	Monitor	0.002	Monitor	0.002
Copper	Monitor	0.8	Monitor	0.8	Monitor	0.8
Iron	Monitor	1.4	Monitor	1.4	Monitor	1.4
Lead	0.05	0.04	0.05	0.04	0.05	0.04

TABLE 4.1-7 Semi-Annual Compliance Groundwater Monitoring (in mg/L unless otherwise noted)						
Parameter	POC Well # M54-LBF (Continued)		POC Well # M54-O (Continued)		POC Well # M52-UBF (Continued)	
	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)	AQL (mg/l)	AL (mg/l)
Manganese	Monitor	0.52	Monitor	0.52	Monitor	0.52
Mercury	0.002	0.0016	0.002	0.0016	0.002	0.0016
Nickel	0.1	0.08	0.1	0.08	0.1	0.08
Selenium	0.05	0.04	0.05	0.04	0.05	0.04
Thallium	0.002	0.0016	0.002	0.0016	0.002	0.0016
Zinc	Monitor	4	Monitor	4	Monitor	4
Adjusted Gross Alpha <sup>4</sup> (pCi/L)	26.5	Monitor	26.5	Monitor	26.5	Monitor
Radium 226 + 228 (pCi/L)	17.2	Monitor	17.2	Monitor	17.2	Monitor
Uranium Isotopes <sup>5</sup> (pCi/L)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Uranium, Total (µg/L)	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Total petroleum hydrocarbons- diesel	Monitor	Monitor	Monitor	Monitor	Monitor	Monitor
Benzene	0.005	0.004	0.005	0.004	0.005	0.004
Ethylbenzene	0.7	0.56	0.7	0.56	0.7	0.56
Toluene	1.0	0.08	1.0	0.08	1.0	0.08
Total Xylene	10	8	10	8	10	8

1. Metals must be analyzed as dissolved metals.
2. Monitor = Monitoring required, but no AQL or AL will be established in the permit.
3. The Alert Level for Arsenic is a narrative standard that is applied in order to protect downgradient users and will be revised, as necessary, in accordance with Section 2.5.7 and Section 3.0 to ensure that the UPL of 0.01 mg/L is not exceeded at the downgradient edge of the State Mineral Lease Land.
4. If the gross alpha particle activity is greater than the AL or AQL, then calculate the adjusted gross alpha particle activity. The adjusted gross alpha particle activity is the gross alpha particle activity, including radium 226, and any other alpha emitters, if present in the water sample, minus radon and total uranium (the sum of uranium 238, uranium 235 and uranium 234 isotopes). The gross alpha analytical procedure (evaporation technique: EPA Method 900.0) drives off radon gas in the water samples. Therefore, the Adjusted Gross Alpha should be calculated using the following formula: (Laboratory Reported Gross Alpha MINUS Sum of the Uranium Isotopes).
5. Uranium Isotope activity results must be used for calculating Adjusted Gross Alpha.



<b>Table 4.1-7B Semi-Annual Operational Groundwater Monitoring</b>				
<b>Parameter</b>	<b>Supplemental Well M55-UBF</b>	<b>Supplemental Well M56-LBF</b>	<b>Supplemental Well M57-O</b>	<b>Supplemental Well M-58-O</b>
	<b>AL (mg/l)</b>	<b>AL (mg/l)</b>	<b>AL (mg/l)</b>	<b>AL (mg/l)</b>
Depth to Groundwater (ft bgs)	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor
pH- field) (S.U.)	Monitor	Monitor	Monitor	Monitor
Specific conductance - field) (µmhos/cm)	Monitor	Monitor	Monitor	Monitor
Temperature -field(°F)	Monitor	Monitor	Monitor	Monitor
pH (lab)	Monitor	Monitor	Monitor	Monitor
Bicarbonate	Monitor	Monitor	Monitor	Monitor
Calcium	Monitor	Monitor	Monitor	Monitor
Carbonate	Monitor	Monitor	Monitor	Monitor
Chloride	Monitor	Monitor	Monitor	Monitor
Fluoride	3.2	3.2	3.2	3.2
Magnesium	50	46	20	59
Nitrate as nitrogen <sup>1</sup>	Monitor	Monitor	Monitor	Monitor
Potassium	Monitor	Monitor	Monitor	Monitor
Sodium	Monitor	Monitor	Monitor	Monitor
Sulfate	484	312	200	435
Total dissolved solids	1900	1646	934	1716
Cation/anion balance	Monitor	Monitor	Monitor	Monitor
Aluminum	0.16	0.16	0.16	0.16
Antimony	0.0048	0.0048	0.0048	0.0048
Arsenic	0.026	0.026	0.026	0.026
Barium	1.6	1.6	1.6	1.6
Beryllium	0.0032	0.0032	0.0032	0.0032
Cadmium	0.004	0.004	0.004	0.004
Chromium (total)	0.08	0.08	0.08	0.08
Cobalt	0.002	0.002	0.002	0.002
Copper	0.8	0.8	0.8	0.8
Iron	1.4	1.4	1.4	1.4
Lead	0.04	0.04	0.04	0.04
Manganese	0.52	0.52	0.52	0.52

Table 4.1-7B Semi-Annual Operational Groundwater Monitoring				
Parameter	Supplemental Well M55-UBF (Continued)	Supplemental Well M56-LBF (Continued)	Supplemental Well M57-O (Continued)	Supplemental Well M-58-O (Continued)
	AL (mg/l)	AL (mg/l)	AL (mg/l)	AL (mg/l)
Mercury	0.0016	0.0016	0.0016	0.0016
Nickel	0.08	0.08	0.08	0.08
Selenium	0.04	0.04	0.04	0.04
Thallium	0.0016	0.0016	0.0016	0.0016
Zinc	4	4	4	4
Gross Alpha (pCi/l)	15	15	15	15
Adjusted Alpha <sup>2,3</sup>	26.5	26.5	26.5	26.5
Radium 226 + 228 <sup>2</sup>	17.2	17.2	17.2	17.2
Uranium Isotopes <sup>2</sup>	Monitor	Monitor	Monitor	Monitor
Uranium (total)	Monitor	Monitor	Monitor	Monitor
TPH - diesel	Monitor	Monitor	Monitor	Monitor
Benzene	0.004	0.004	0.004	0.004
Ethylbenzene	0.56	0.56	0.56	0.56
Toluene	0.8	0.8	0.8	0.8
Total Xylene	8	8	8	8

Table 4.1-7B Semi-Annual Operational Groundwater Monitoring					
Parameter	Supplemental Well M-59-O	Supplemental Well M-60-O	Supplemental Well M-61-LBF	Operational Monitor Well MW-01-LBF	Operational Monitor Well MW-01-O
	AL (mg/l)	AL (mg/l)	AL (mg/l)	AL (mg/l)	AL (mg/l)
Depth to Groundwater (ft bgs)	Monitor	Monitor	Monitor	Monitor	Monitor
Water Level Elevation (ft amsl)	Monitor	Monitor	Monitor	Monitor	Monitor
pH- field) (S.U.)	Monitor	Monitor	Monitor	Monitor	Monitor
Specific conductance - field) (µmhos/cm)	Monitor	Monitor	Monitor	Monitor	Monitor
Temperature field(°F)	Monitor	Monitor	Monitor	Monitor	Monitor
pH (lab)	Monitor	Monitor	Monitor	Monitor	Monitor
Bicarbonate	Monitor	Monitor	Monitor	Monitor	Monitor
Calcium	Monitor	Monitor	Monitor	Monitor	Monitor
Carbonate	Monitor	Monitor	Monitor	Monitor	Monitor
Chloride	Monitor	Monitor	Monitor	Monitor	Monitor
Fluoride	3.2	3.2	3.2	3.2	3.2
Magnesium	27	54	13	47	48
Nitrate as Nitrogen <sup>1</sup>	Monitor	Monitor	Monitor	Monitor	Monitor
Potassium	Monitor	Monitor	Monitor	Monitor	Monitor
Sodium	Monitor	Monitor	Monitor	Monitor	Monitor
Sulfate	234	313	200	340	254
Total dissolved solids	947	1492	852	1711	1563
Cation/anion balance	Monitor	Monitor	Monitor	Monitor	Monitor
Aluminum	0.16	0.16	0.16	0.16	0.16
Antimony	0.0048	0.0048	0.0048	0.0048	0.0048
Arsenic	0.026	0.026	0.026	0.026	0.026
Barium	1.6	1.6	1.6	1.6	1.6
Beryllium	0.0032	0.0032	0.0032	0.0032	0.0032
Cadmium	0.004	0.004	0.004	0.004	0.004

Table 4.1-7B Semi-Annual Operational Groundwater Monitoring					
Parameter	Supplemental Well M-59-O (Continued)	Supplemental Well M-60-O (Continued)	Supplemental Well M61-LBF (Continued)	Supplemental Well MW-01-LBF (Continued)	Supplemental Well MW-01-O (Continued)
Chromium (total)	0.08	0.08	0.08	0.08	0.08
Cobalt	0.002	0.002	0.002	0.002	0.002
Copper	0.8	0.8	0.8	0.8	0.8
Iron	1.4	1.4	1.4	1.4	1.4
Lead	0.04	0.04	0.04	0.04	0.04
Manganese	0.52	0.52	0.52	0.52	0.52
Mercury	0.0016	0.0016	0.0016	0.0016	0.0016
Nickel	0.08	0.20	0.08	0.08	0.08
Selenium	0.04	0.04	0.04	0.04	0.04
Thallium	0.0016	0.0016	0.0016	0.0016	0.0016
Zinc	4	4	4	5.6	4
Gross Alpha	15	15	15	15	15
Adjusted Alpha <sup>2,3</sup>	26.5	26.5	26.5	26.5	26.5
Radium 226 + 228 <sup>2</sup>	17.2	17.2	17.2	17.2	17.2
Uranium Isotopes <sup>2</sup>	Monitor	Monitor	Monitor	Monitor	Monitor
Uranium (total)	0.16	0.16	0.16	0.16	0.16
TPH - diesel	Monitor	Monitor	Monitor	Monitor	Monitor
Benzene	0.004	0.004	0.004	0.004	0.004
Ethylbenzene	0.56	0.56	0.56	0.56	0.56
Toluene	0.8	0.8	0.8	0.8	0.8
Total Xylene	8	8	8	8	8

- |   |  |
|---|--|
| <ol style="list-style-type: none"><li>1. Nitrate will be used only for calculation of cation/anion balance because of regional nitrate pollution and none used in processes.</li><li>2. These parameters are to be analyzed for only if the concentration of Gross Alpha Particle Activity exceeds the established alert level.</li><li>3. If the gross alpha particle activity is greater than 12 pCi/l, then calculate the adjusted gross alpha particle activity. The adjusted gross alpha particle activity is the gross alpha particle activity, including radium 226, and any other alpha emitters, if present in the water sample, minus radon and total uranium (the sum of uranium 238, uranium 235 and uranium 234 isotopes). The gross alpha analytical procedure (evaporation technique: EPA Method 900.0) drives off radon gas in the water samples. Therefore, the Adjusted Gross Alpha should be calculated using the following formula: (Laboratory Reported Gross Alpha MINUS Sum of the Uranium Isotopes).</li></ol> <p>AL = Alert Level<br/>ft amsl = feet above mean sea level<br/>ft bgs = feet below ground surface<br/>mg/L = milligrams per liter<br/>mhos/cm = mhos per centimeter<br/>S.U. = Standard Units</p> |  |
|---|--|

**TABLE 4.1-8  
In-Situ BADCT Monitoring**

Parameter	Wells Monitored	Monitoring Frequency	Alert Level	Method	Reporting Frequency
Injection Rate of well field	All Injection Wells	Monthly average	When Greater than 240gpm	Flow Meter	Monthly
Recovery Rate of well field	All Recovery Wells	Monthly average	Maximum 300 gpm	Flow Meter	Monthly
Recovered Volume to Injection Volume	Comparison of all Injection Wells and all Recovery Wells	Daily	Recovered Volume is Less than Injected Volume	Flow Meter	Weekly
Inward Hydraulic Gradient	Four Injection Wells and Four Observation Wells	Daily average	Less than 1-foot differential as a daily average*	Transducer	Weekly
Maximum Injection Pressure	All Injection Wells	Daily	When Greater than 0.65 psi/ft.	Pressure Gauge	Weekly
LBFU Bulk Electrical Conductivity	Measured at Sensors Installed on All Observation Wells	Weekly	See below	Exclusion Zone/LBFU Conductivity Sensors	Quarterly

**LBFU Bulk Electrical Conductivity Alert Levels**

Electrode Pair Horizon	Alert Level ( $\Omega$ -m)
Horizon 1	9.67
Horizon 2	9.89
Horizon 3	10.07

Horizon 1 includes all electrode pairs approximately 40 feet above the LBFU/Oxide contact

Horizon 2 includes all electrode pairs approximately 20 feet above the LBFU/Oxide contact

Horizon 3 includes all electrode pairs approximately at the LBFU/Oxide contact

An AL exceedance is defined for this permit when Bulk EC measurements at three crossing or adjacent pathways (sensor pairs) within a horizon exceed the AL established for that horizon.

Well Bore Electrical Conductivity	Measured at Sensors Installed Above MFGU on ALL Observation Wells, Supplemental Wells, Operational Monitoring Well (MW-01) and Multi-Level Sampling Wells	Quarterly	Current Value Greater than Previous Value	Annular Conductivity Device	Quarterly
Fluid Electrical Conductivity	Comparison of Fluid Sample Collected From All Observation Wells and All Injection Wells	Daily	Observation Well Conductivity Equal to or Greater than Injection Well Conductivity	Fluid Sample	Quarterly
Cone of Depression	Potentiometric Surface Map Compiled using Water Levels Measured at All Observation Wells, Supplemental Monitoring Wells Completed in the Oxide, Operational Monitoring Well MW-01, and POC Wells Completed in the Oxide	Compiled Monthly	Groundwater Elevation at Downgradient Edge of PMA Boundary (as measured at M54-O) is Higher than Groundwater Elevation at the Downgradient PTF Observation Well	Potentiometric Surface Map	Quarterly

\*Per monitoring of designated 4-pairs of observation/recovery wells (EPA UIC Class III)



**5.0 REFERENCES AND PERTINENT INFORMATION**

The terms and conditions set forth in this permit have been developed based upon the information contained in the following, which are on file with the Department:

1. Other Amendment Application Received January 17, 2020

**6.0 NOTIFICATION PROVISIONS****6.1 Annual Registration Fees**

The permittee is notified of the obligation to pay an Annual Registration Fee to ADEQ. The Annual Registration Fee is based upon the amount of daily influent or discharge of pollutants in gallons per day as established by A.R.S. § 49-242.

**6.2 Duty to Comply [A.R.S. §§ 49-221 through 49-263]**

The permittee is notified of the obligation to comply with all conditions of this permit and all applicable provisions of Title 49, Chapter 2, Articles 1, 2 and 3 of the Arizona Revised Statutes, Title 18, Chapter 9, Articles 1 through 4, and Title 18, Chapter 11, Article 4 of the Arizona Administrative Code. Any permit non-compliance constitutes a violation and is grounds for an enforcement action pursuant to Title 49, Chapter 2, Article 4 or permit amendment, suspension, or revocation.

**6.3 Duty to Provide Information [A.R.S. §§ 49-243(K)(2) and 49-243(K)(8)]**

The permittee shall furnish to the Director, or an authorized representative, within a time specified, any information which the Director may request to determine whether cause exists for amending or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

**6.4 Compliance with Aquifer Water Quality Standards [A.R.S. §§ 49-243(B)(2) and 49-243(B)(3)]**

The permittee shall not cause or contribute to a violation of an aquifer water quality standard at the applicable point of compliance for the facility. Where, at the time of issuance of the permit, an aquifer already exceeds an aquifer water quality standard for a pollutant, the permittee shall not discharge that pollutant so as to further degrade, at the applicable point of compliance for the facility, the water quality of any aquifer for that pollutant.

**6.5 Technical and Financial Capability**

**[A.R.S. §§ 49-243(K)(8) and 49-243(N) and A.A.C. R18-9-A202(B) and R18-9-A203(E) and (F)]**

The permittee shall have and maintain the technical and financial capability necessary to fully carry out the terms and conditions of this permit. Any bond, insurance policy, trust fund, or other financial assurance mechanism provided as a demonstration of financial capability in the permit application, pursuant to A.A.C. R18-9-A203(D), shall be in effect prior to any discharge authorized by this permit and shall remain in effect for the duration of the permit.

**6.6 Reporting of Bankruptcy or Environmental Enforcement [A.A.C. R18-9-A207(C)]**

The permittee shall notify the Director within five days after the occurrence of any one of the following:

1. The filing of bankruptcy by the permittee.
2. The entry of any order or judgment not issued by the Director against the permittee for the enforcement of any environmental protection statute or rule.

**6.7 Monitoring and Records [A.R.S. § 49-243(K)(8) and A.A.C. R18-9-A206]**

The permittee shall conduct any monitoring activity necessary to assure compliance with this permit, with the applicable water quality standards established pursuant to A.R.S. §§ 49-221 and 49-223 and §§ 49-241 through 49-252.

**6.8 Inspection and Entry [A.R.S. §§ 41-1009, 49-203(B) and 49-243(K)(8)]**

In accordance with A.R.S. §§ 41-1009 and 49-203(B), the permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to enter and inspect the facility as reasonably necessary to ensure compliance with Title 49, Chapter 2, Article 3 of the Arizona Revised Statutes, and Title 18, Chapter 9, Articles 1 through 4 of the Arizona Administrative Code and the terms and conditions of this permit.

**6.9 Duty to Modify [A.R.S. § 49-243(K)(8) and A.A.C. R18-9-A211]**

The permittee shall apply for and receive a written amendment before deviating from any of the designs or operational practices specified by this permit.

**6.10 Permit Action: Amendment, Transfer, Suspension & Revocation**

**[A.R.S. §§ 49-201, 49-241 through 251, A.A.C. R18-9-A211, R18-9-A212 and R18-9-A213]**

This permit may be amended, transferred, renewed, or revoked for cause, under the rules of the Department.

The permittee shall notify the Groundwater Protection Value Stream in writing within 15 days after any change in the owner or operator of the facility. The notification shall state the permit number, the name of the facility, the date of property transfer, and the name, address, and phone number where the new owner or operator can be reached. The operator shall advise the new owner or operators of the terms of this permit and the need for permit transfer in accordance with the rules.

**7.0 ADDITIONAL PERMIT CONDITIONS**

**7.1 Other Information [A.R.S. § 49-243(K)(8)]**

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, the permittee shall promptly submit the correct facts or information.

**7.2 Severability**

**[A.R.S. §§ 49-201, 49-241 through 251, A.A.C. R18-9-A211, R18-9-A212 and R18-9-A213]**

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby. The filing of a request by the permittee for a permit action does not stay or suspend the effectiveness of any existing permit condition.

**7.3 Permit Transfer**

This permit may not be transferred to any other person except after notice to and approval of the transfer by the Department. No transfer shall be approved until the applicant complies with all transfer requirements as specified in A.A.C. R18-9-A212(B) and (C).

